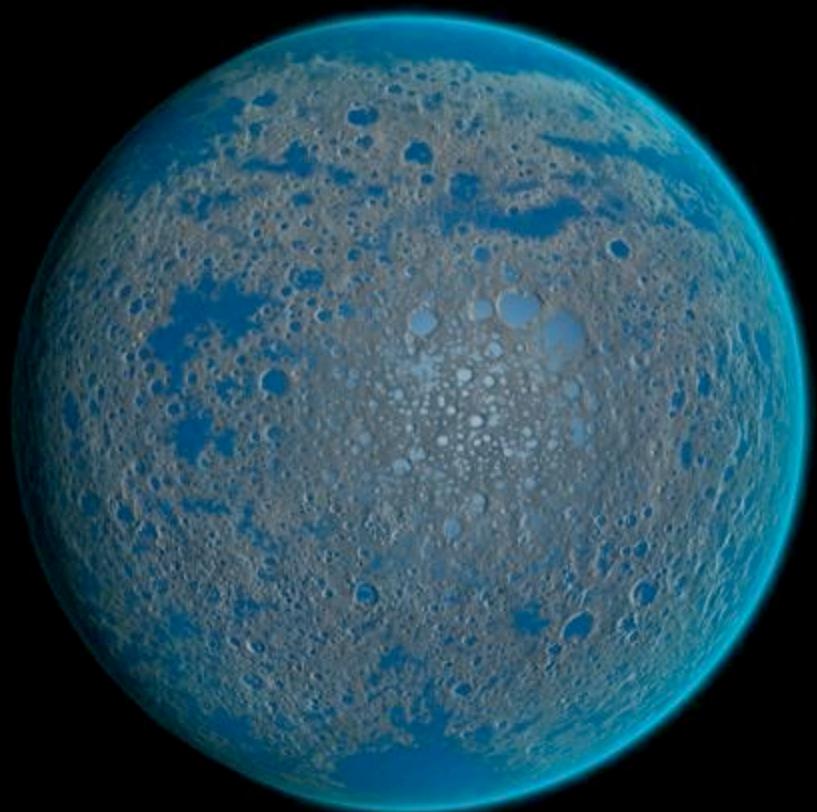


Mawrth Vallis

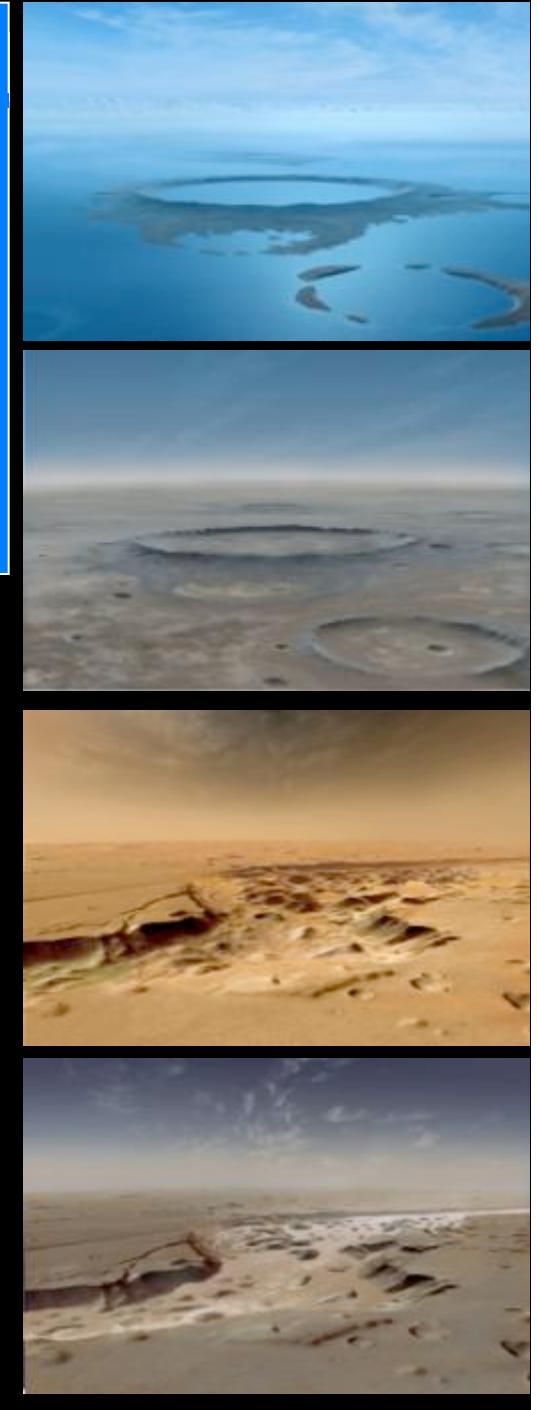
preserving the

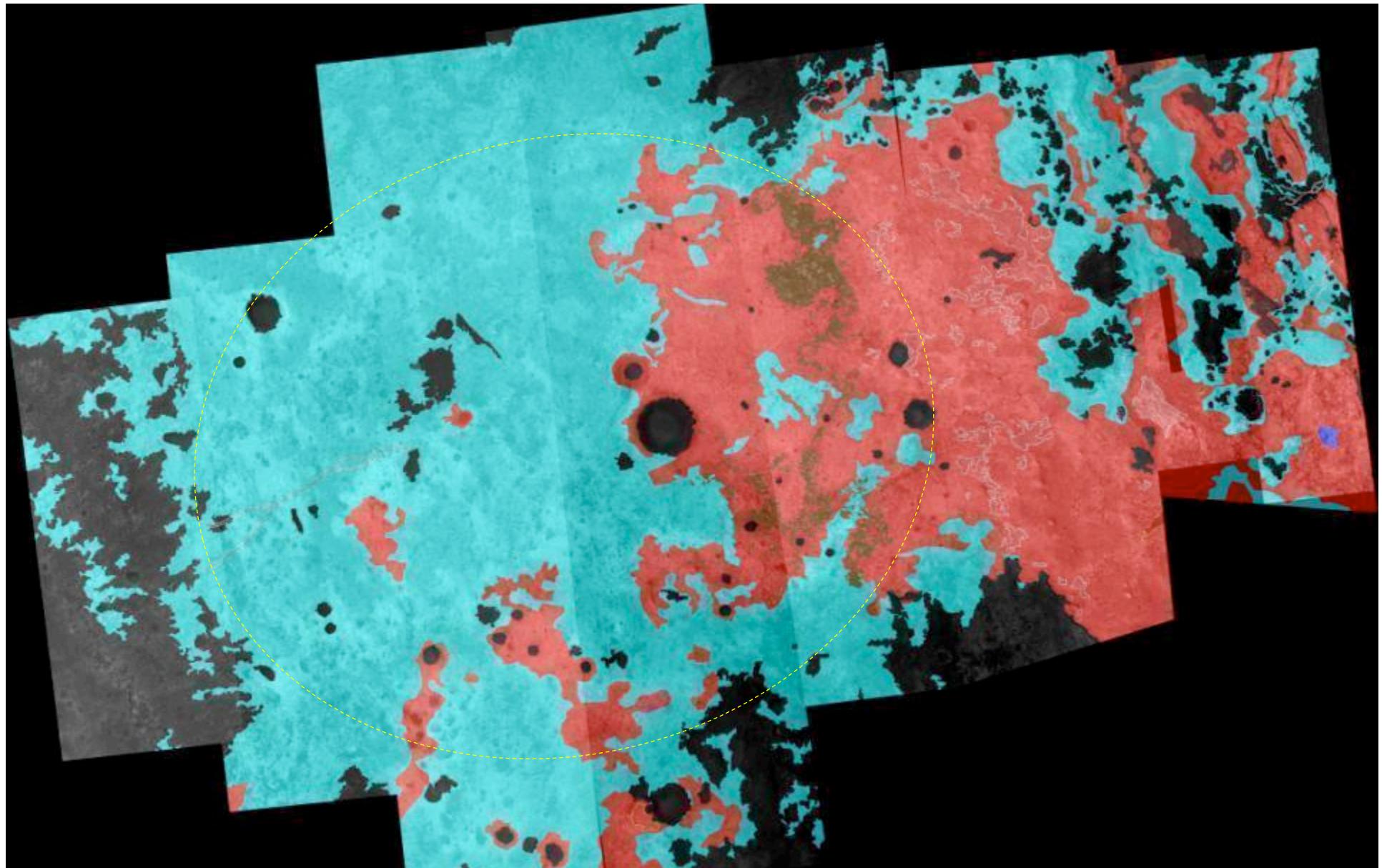
One Day, one Month, one Year at Mawrth Vallis

origins



D. Loizeau, J-P. Bibring, J. Bishop, J. Carter, B. Ehlmann, N. Mangold,
N. McKeown, J. Michalski, J. Mustard, E. Noe Dobrea, M. Parente,
F. Poulet, J. Wray





Dark capping unit



Al-phyllosilicate layers



Fe/Mg-phyllosilicate layers



Possible paleo-sand sheet



Strongly eroded Fe/Mg-phyllosilicate layers



Dark Fe/Mg-phyllosilicate paleo surface

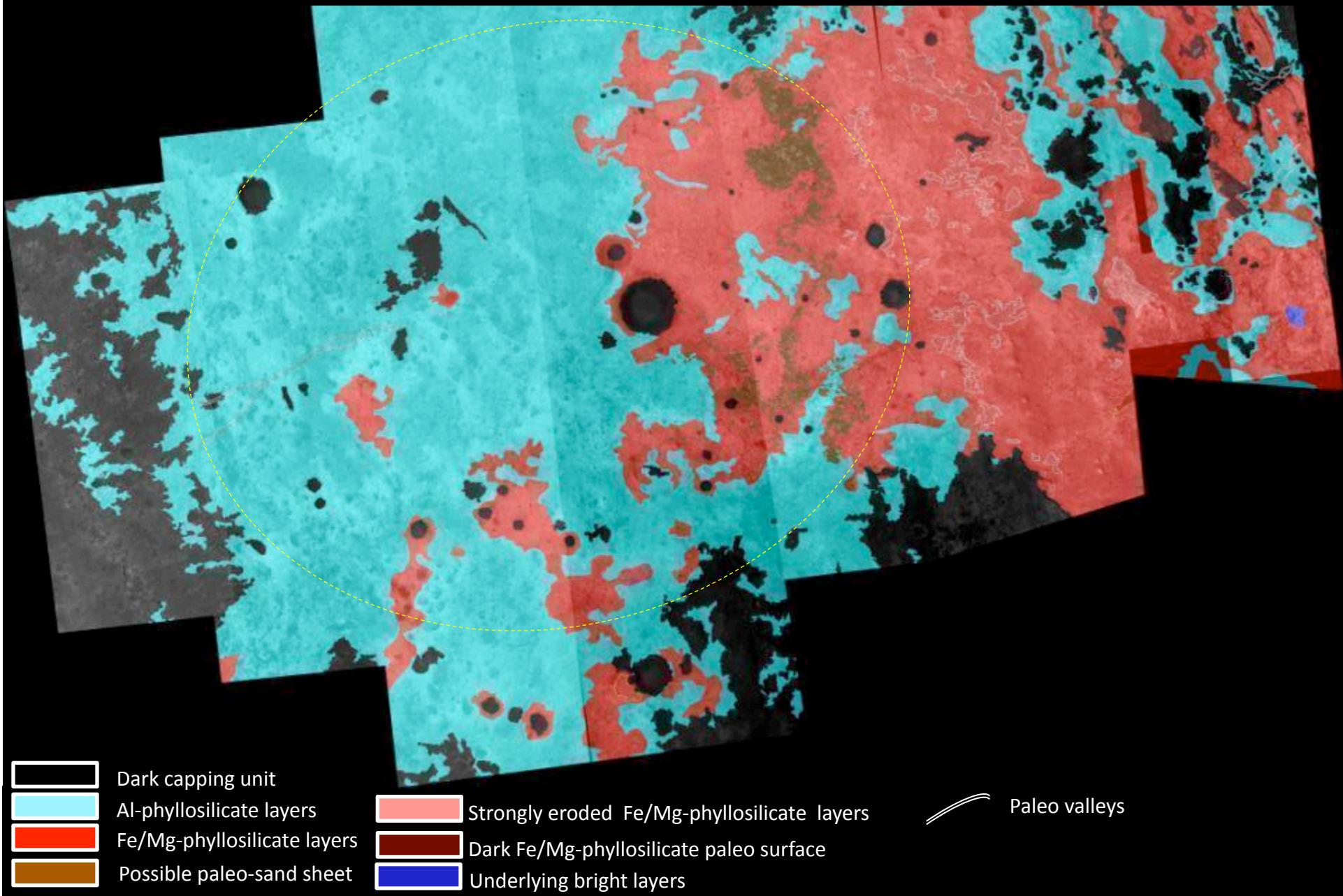


Underlying bright layers

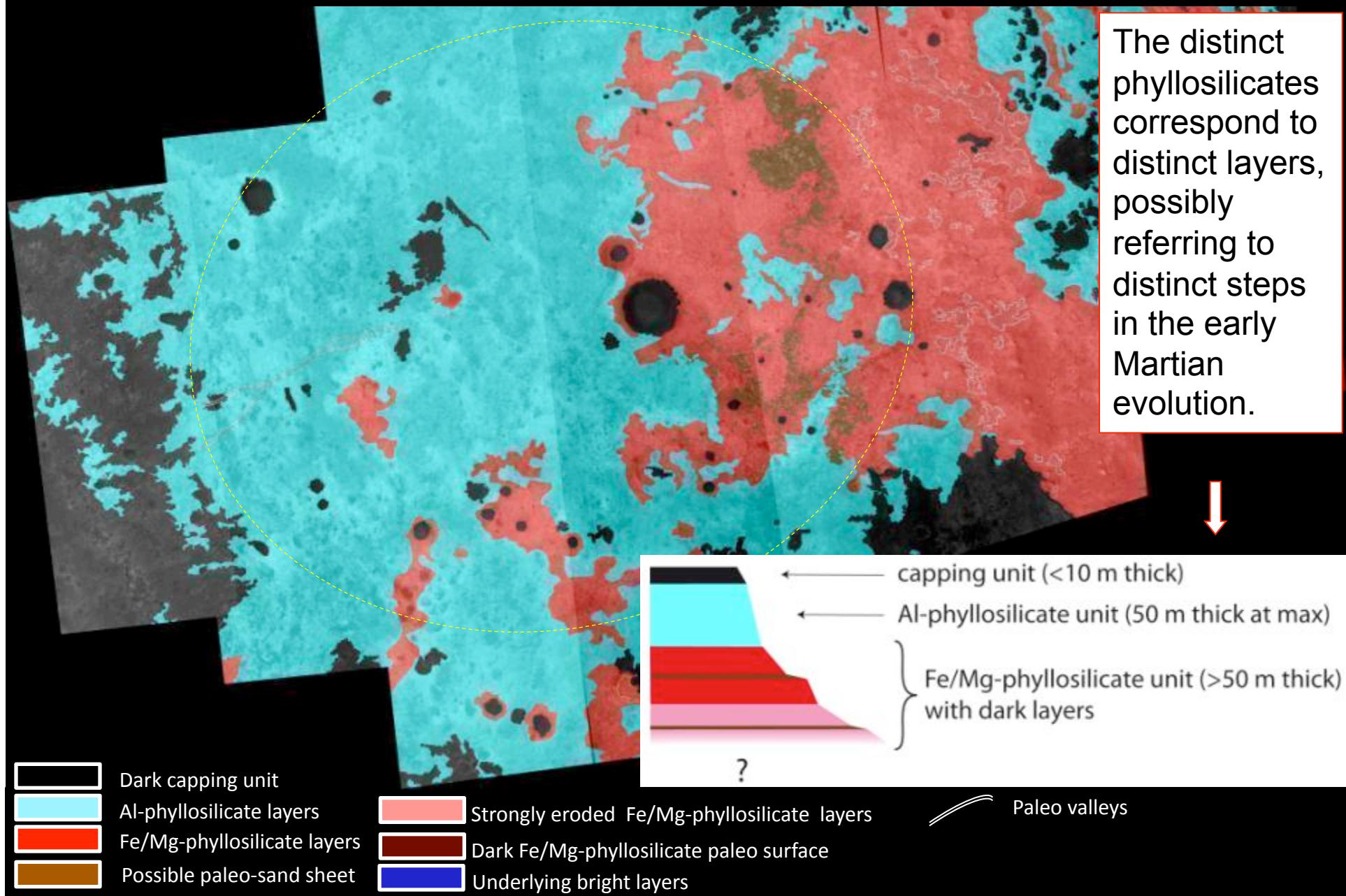


Paleo valleys

Wherever MSL will land within the ellipse, it will access a terrain loaded with hydrated minerals formed at a time Mars might have harbored habitable conditions.



Wherever MSL will land within the ellipse, it will access a terrain loaded with hydrated minerals formed at a time Mars might have harbored habitable conditions.



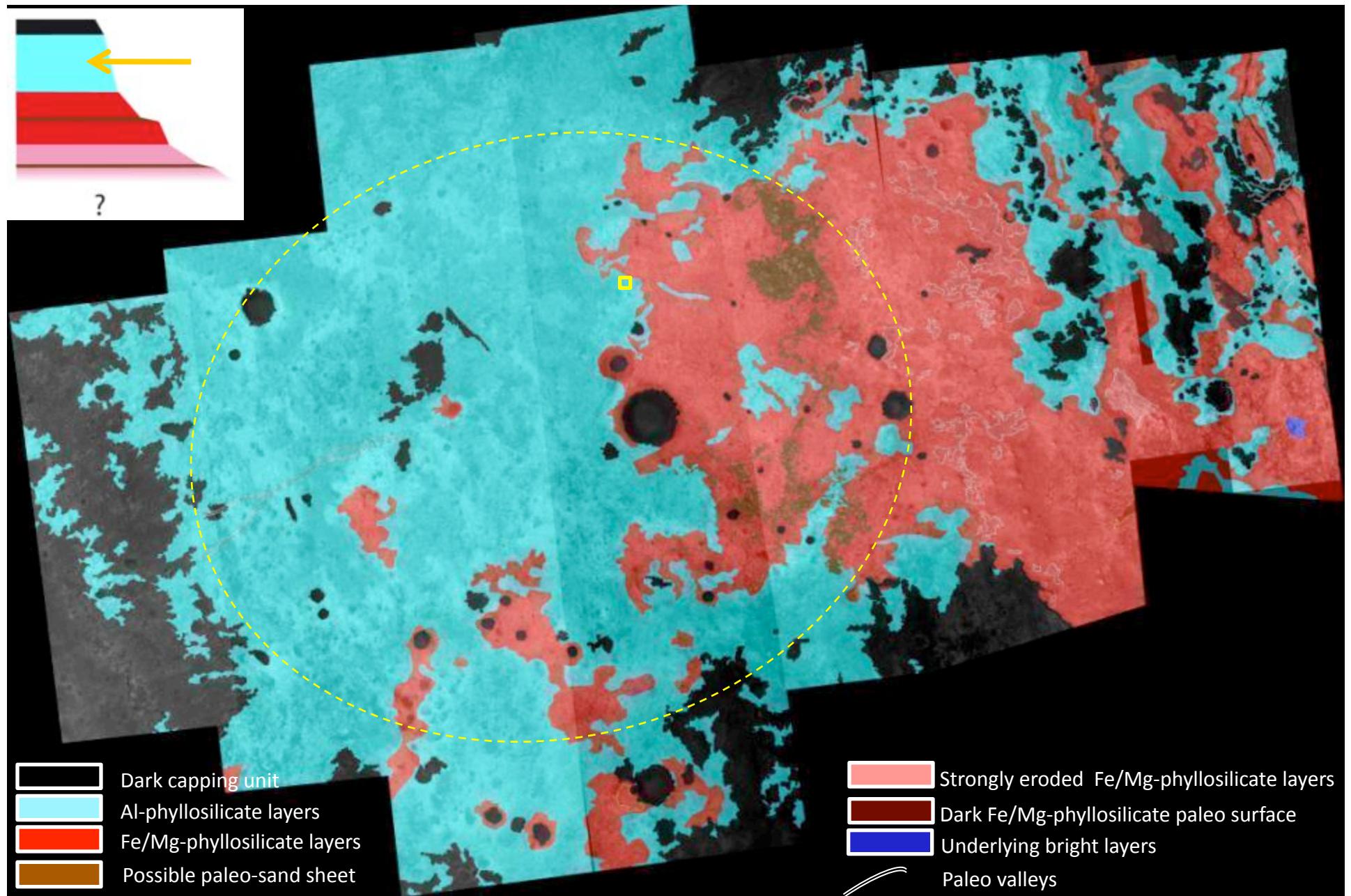
ONE DAY at Mawrth Vallis

The first question “where have we landed” will translate into: “shall we be exploring the most ancient Mars History, and possibly find records of its early aqueous environment?”

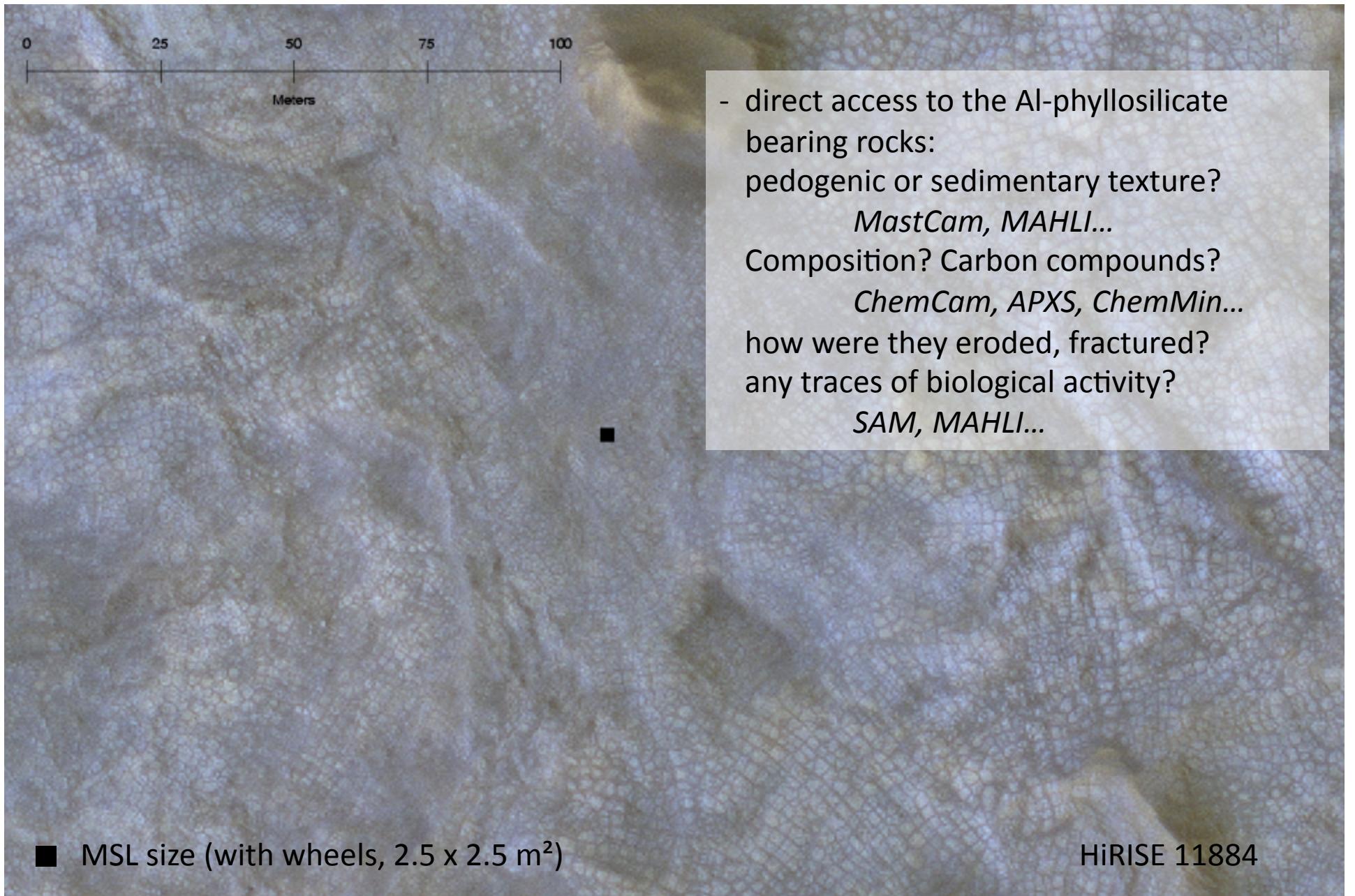
The task of the **first day** at **Mawrth Vallis** will be to characterize the landing site in this respect.

The distinct units have been well imaged by HIRISE. Hereafter we describe what specific environment and “epoch” we might discover, depending where MSL will actually have landed within the ellipse.

Al-phyllosilicate unit



Al-phyllosilicate unit

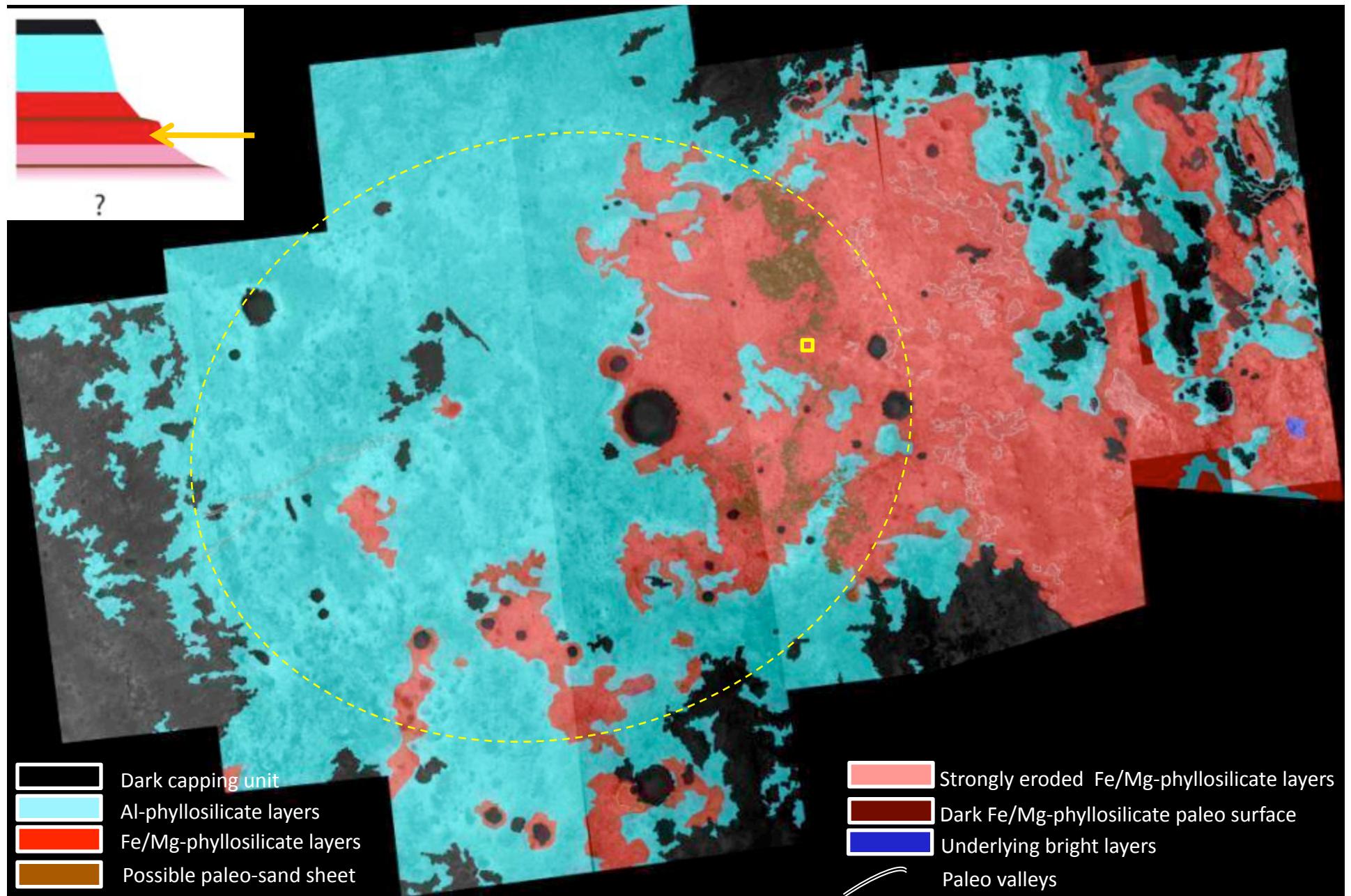


- direct access to the Al-phyllosilicate bearing rocks:
pedogenic or sedimentary texture?
MastCam, MAHLI...
Composition? Carbon compounds?
ChemCam, APXS, ChemMin...
how were they eroded, fractured?
any traces of biological activity?
SAM, MAHLI...

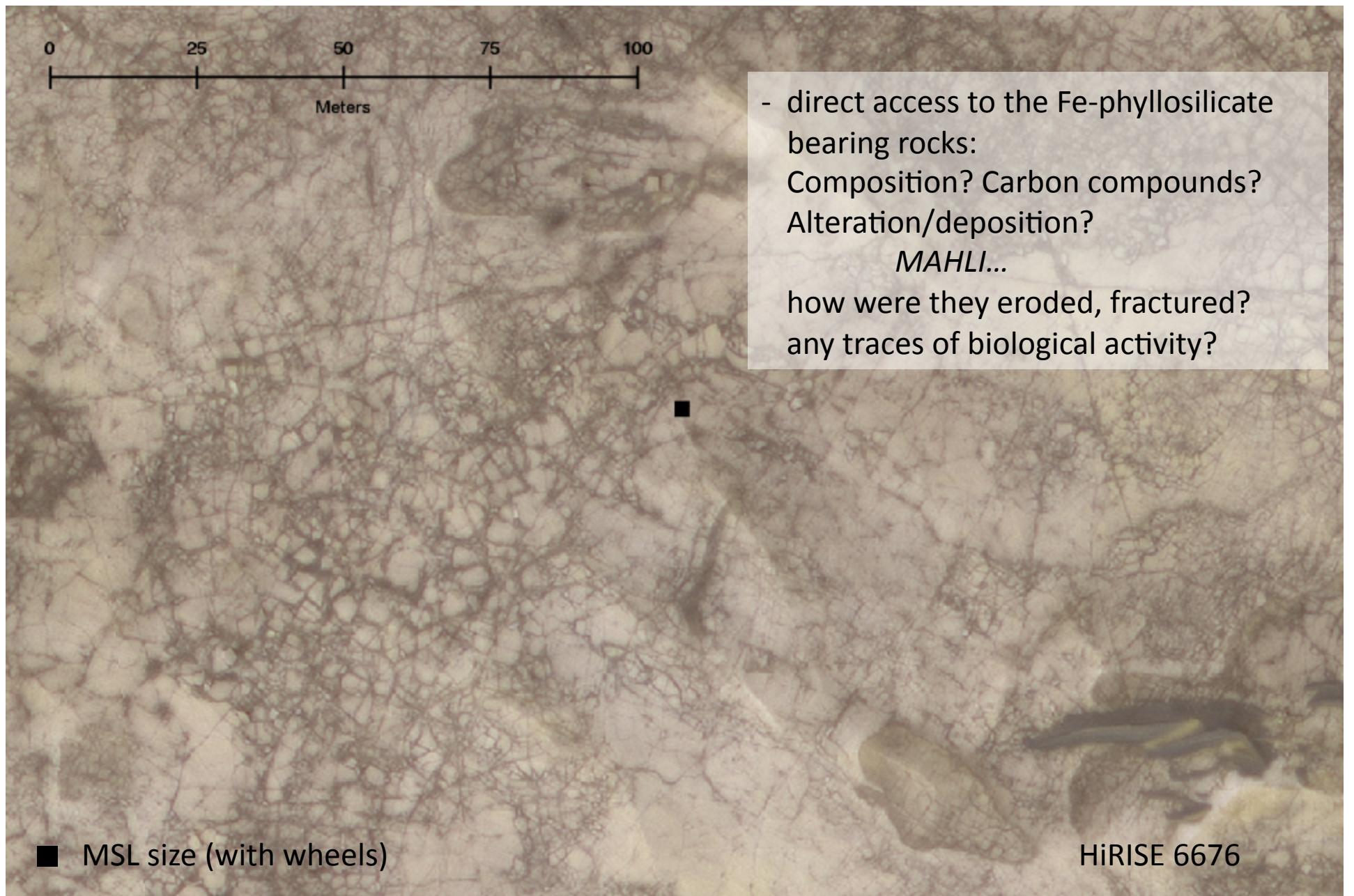
■ MSL size (with wheels, 2.5 x 2.5 m²)

HiRISE 11884

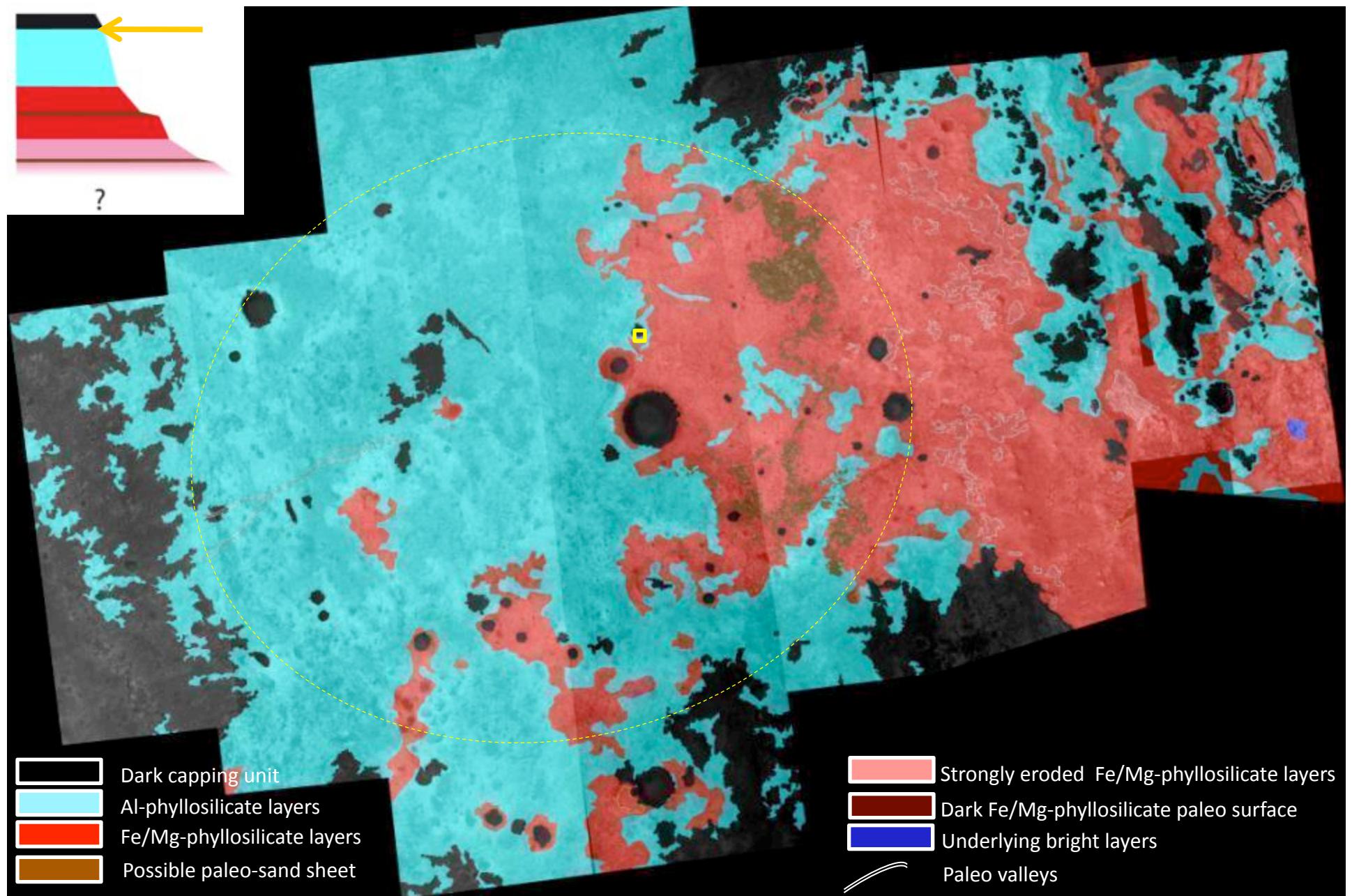
Fe/Mg-phyllosilicate unit



Fe/Mg-phyllosilicate unit

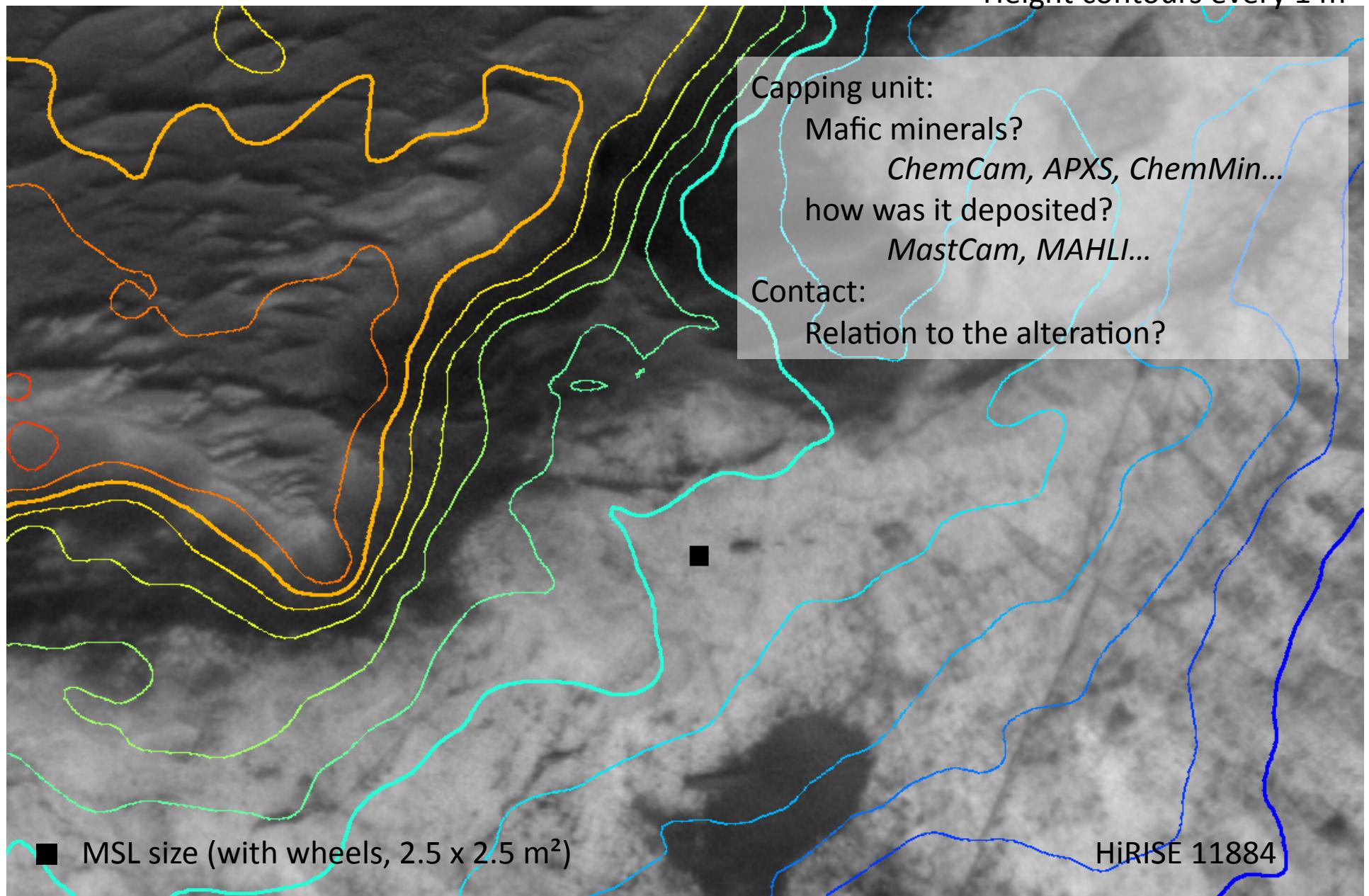


Contact between capping unit and clays



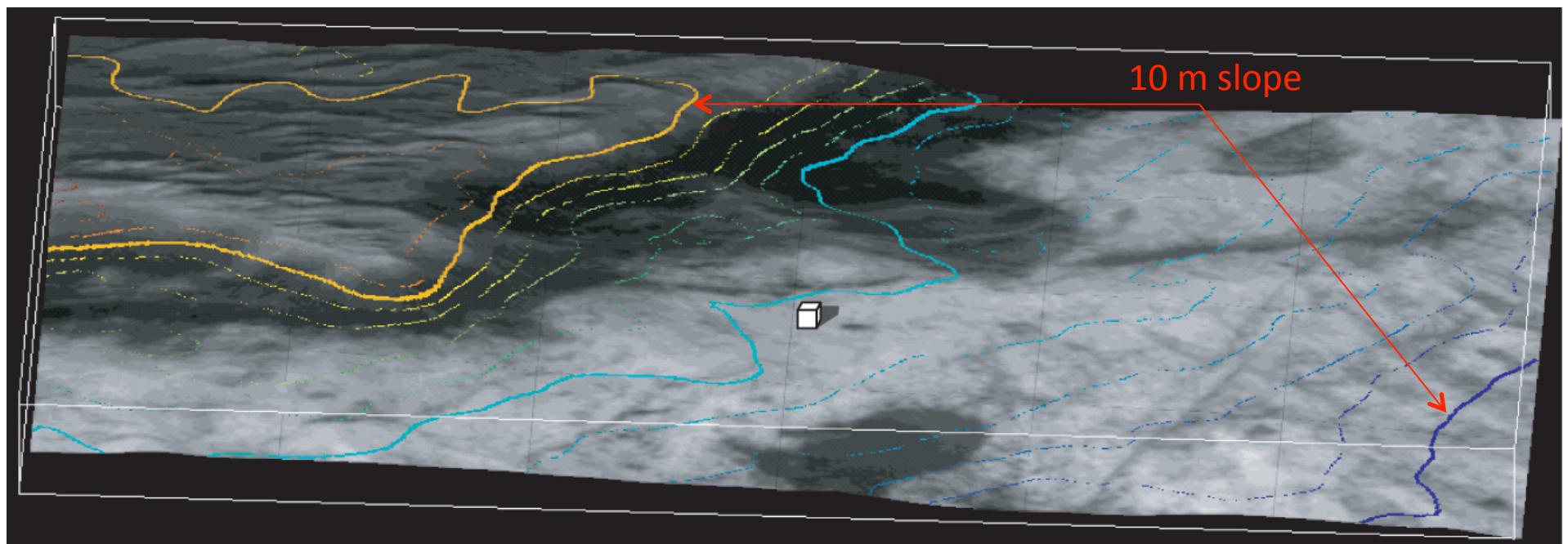
Contact between capping unit and clays

Height contours every 1 m

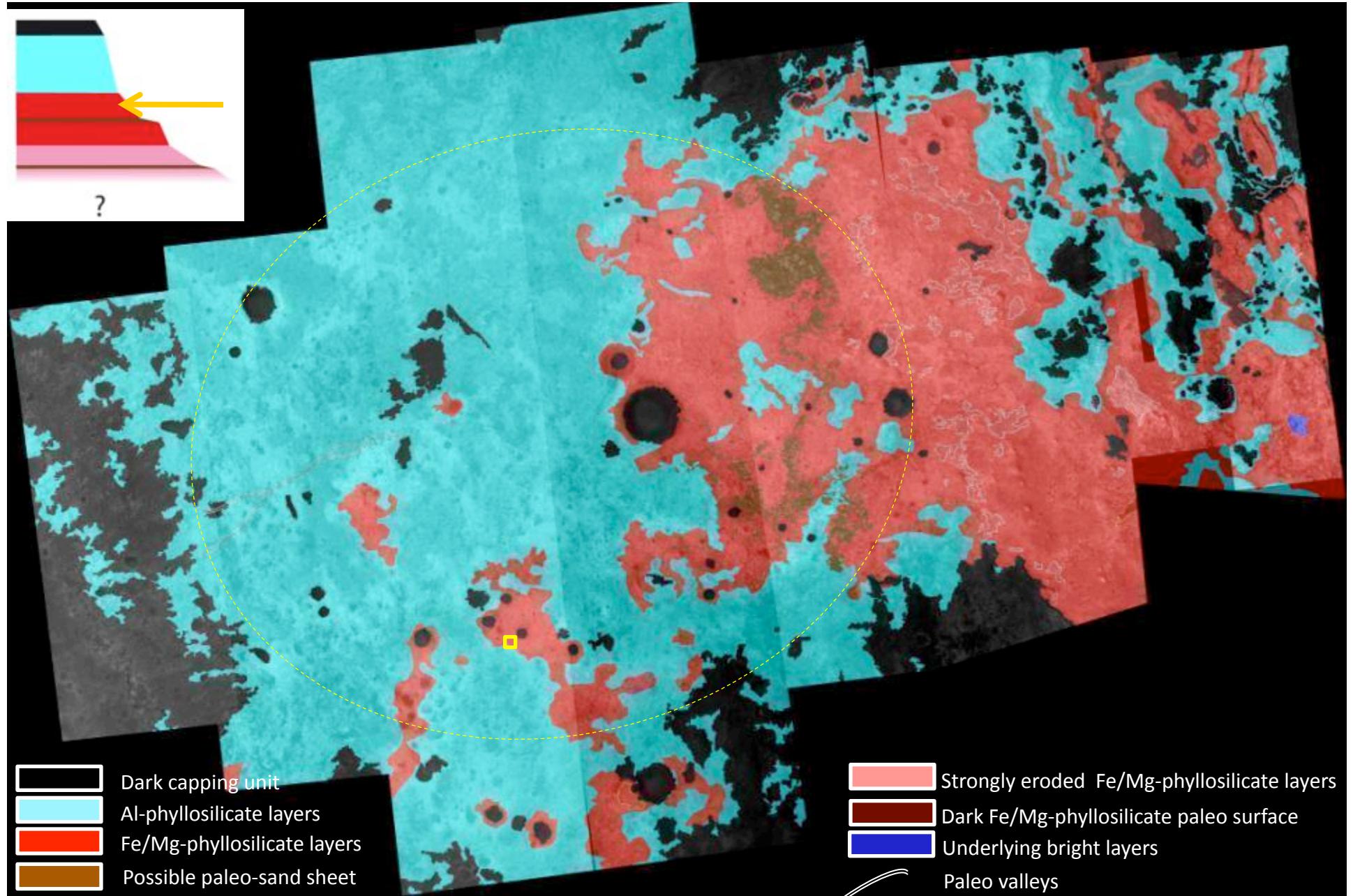


Contact between capping unit and clays

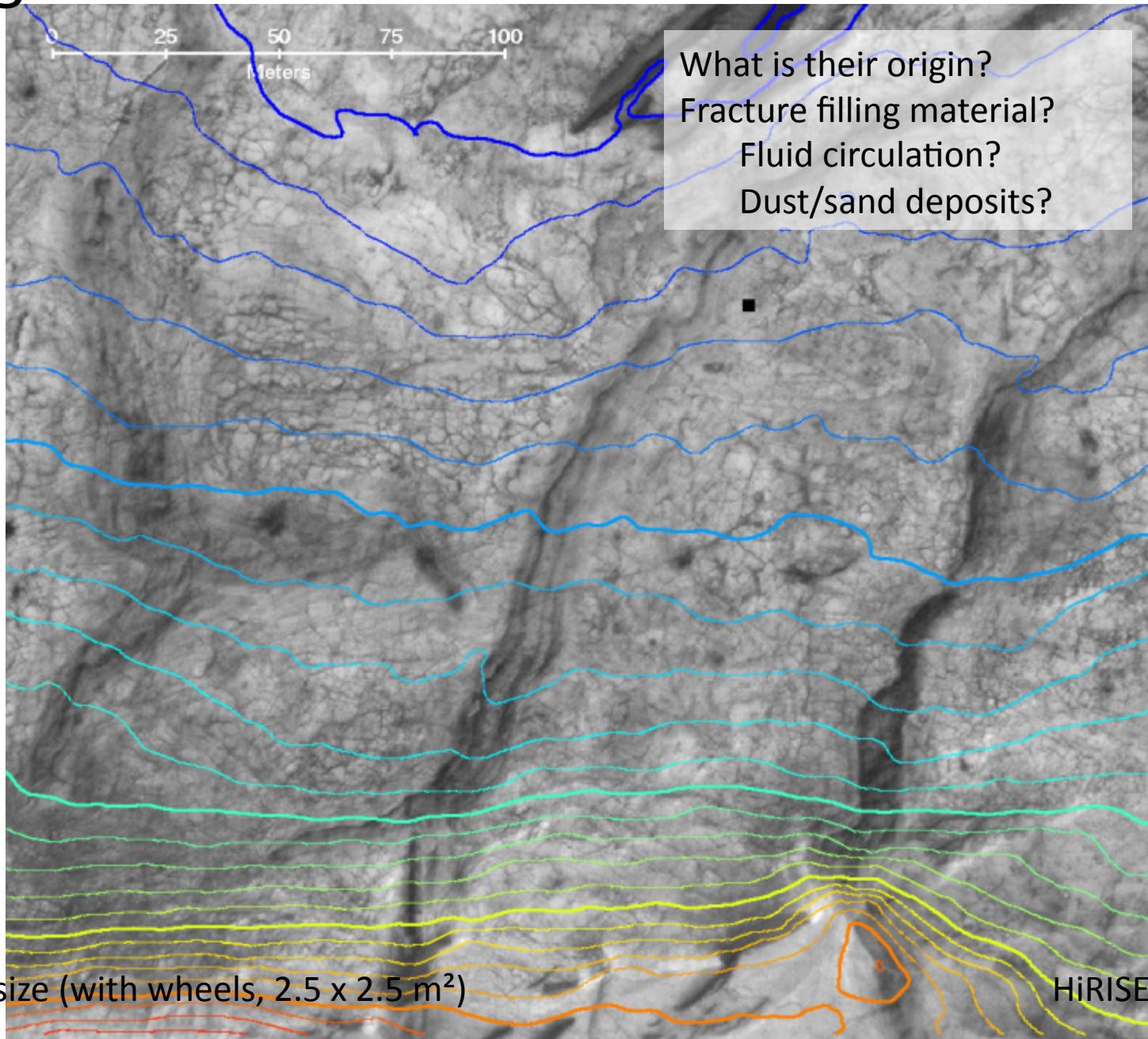
No vertical exaggeration
Height contours every 1 m



Large fractures

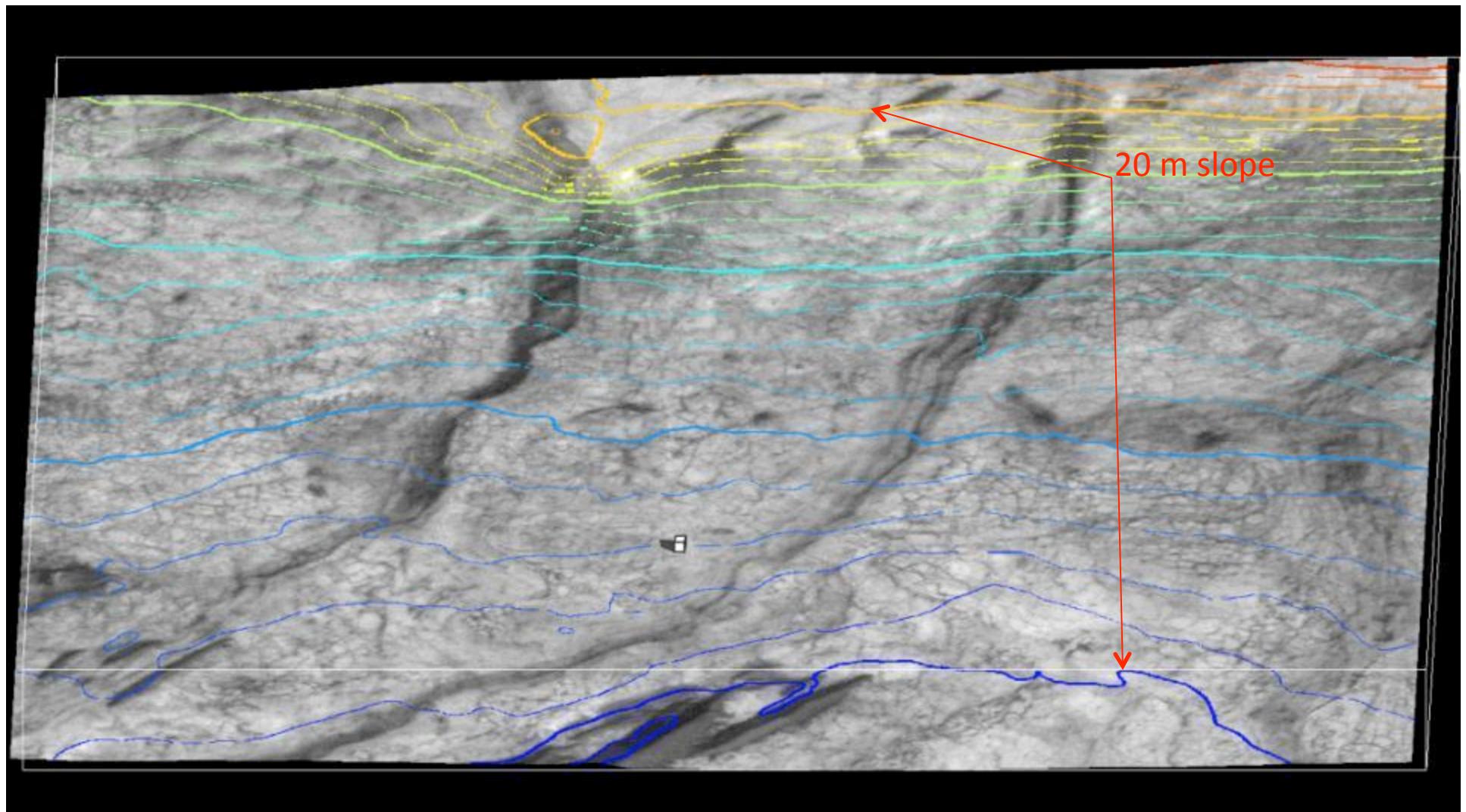


Large fractures



Large fractures

No vertical exaggeration
Height contours every 1 m

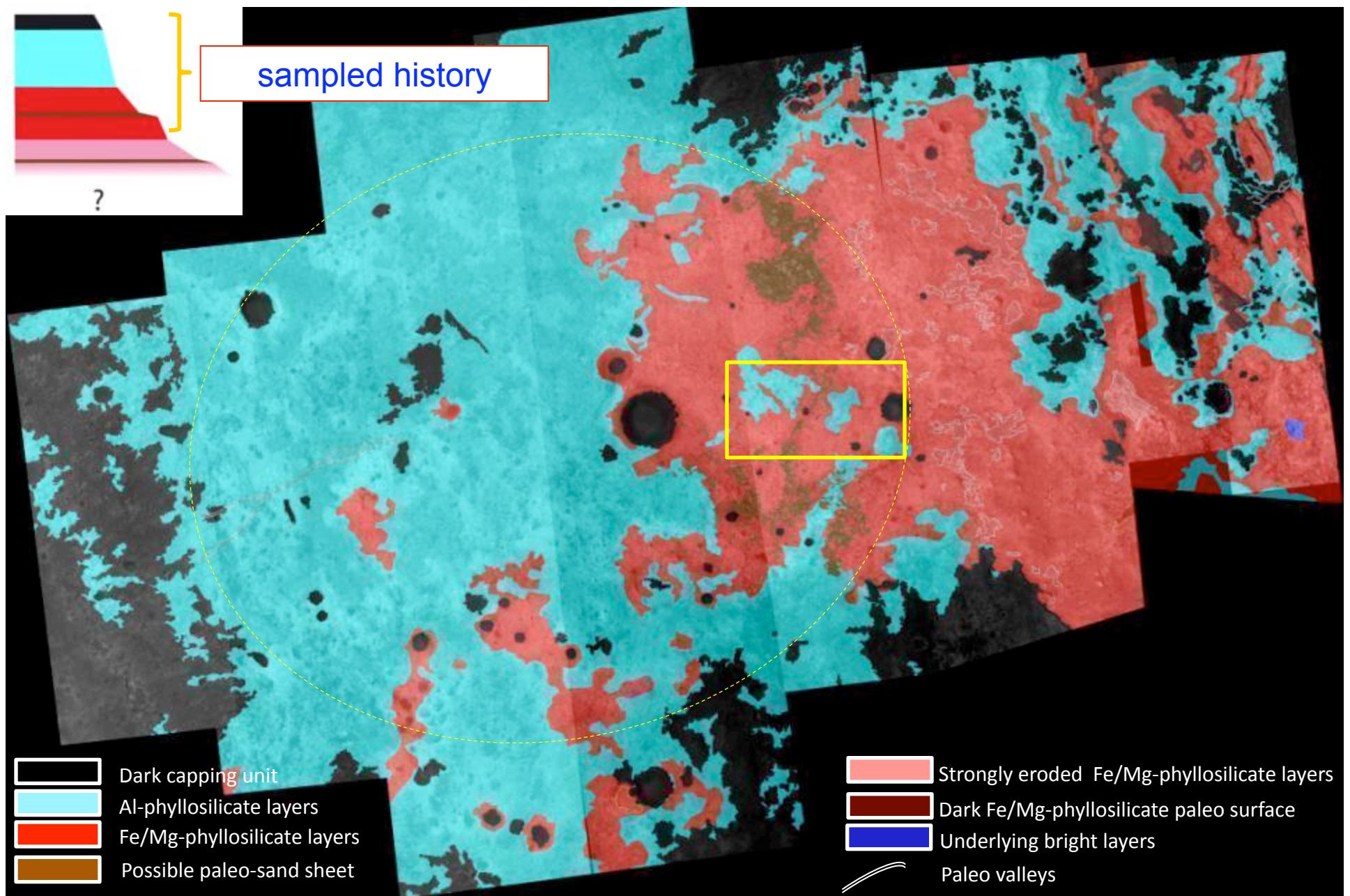


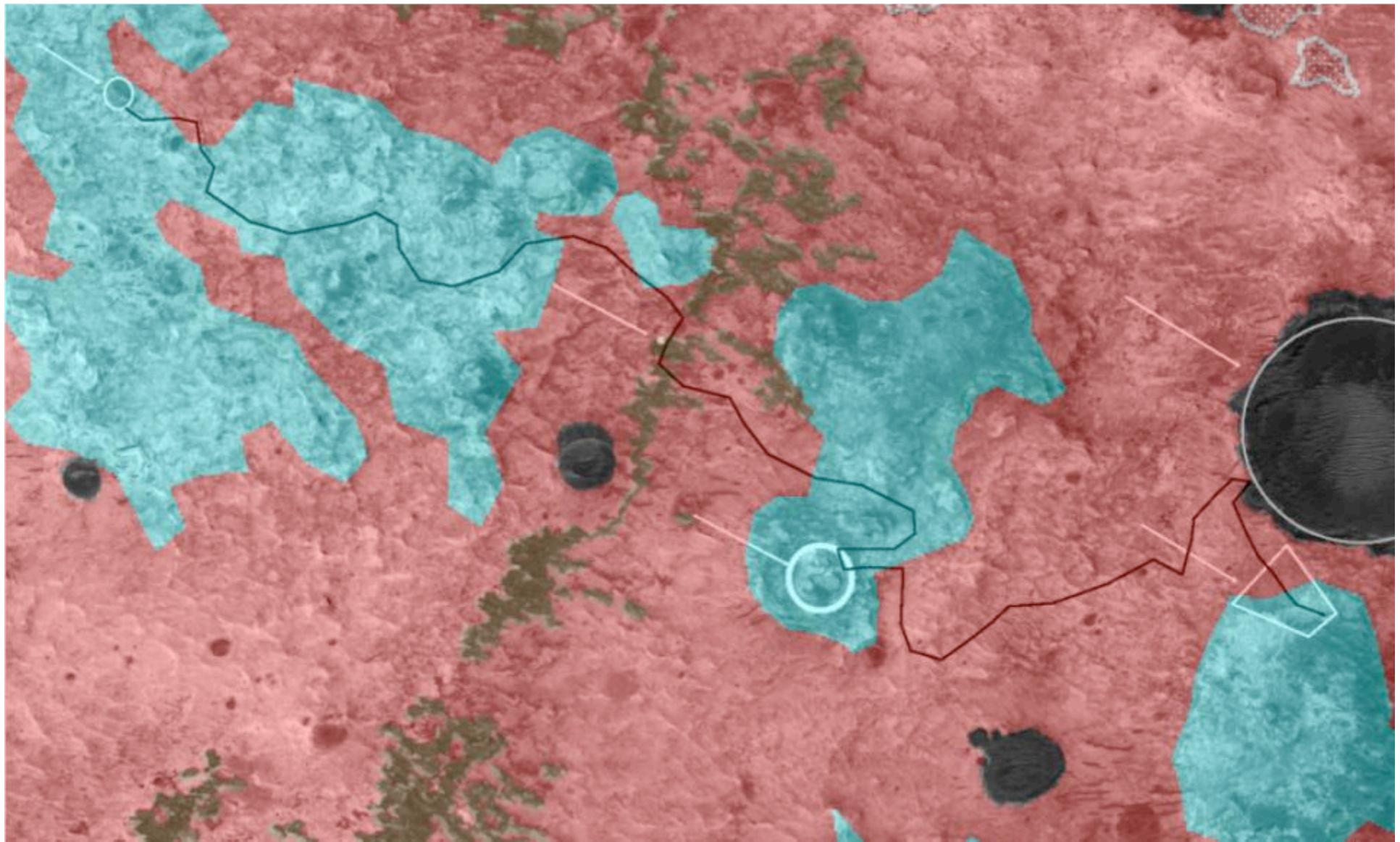
ONE MONTH at Mawrth Vallis

What diversity of sites can MSL access and document?
What part of ancient Mars history can MSL discover and characterize?

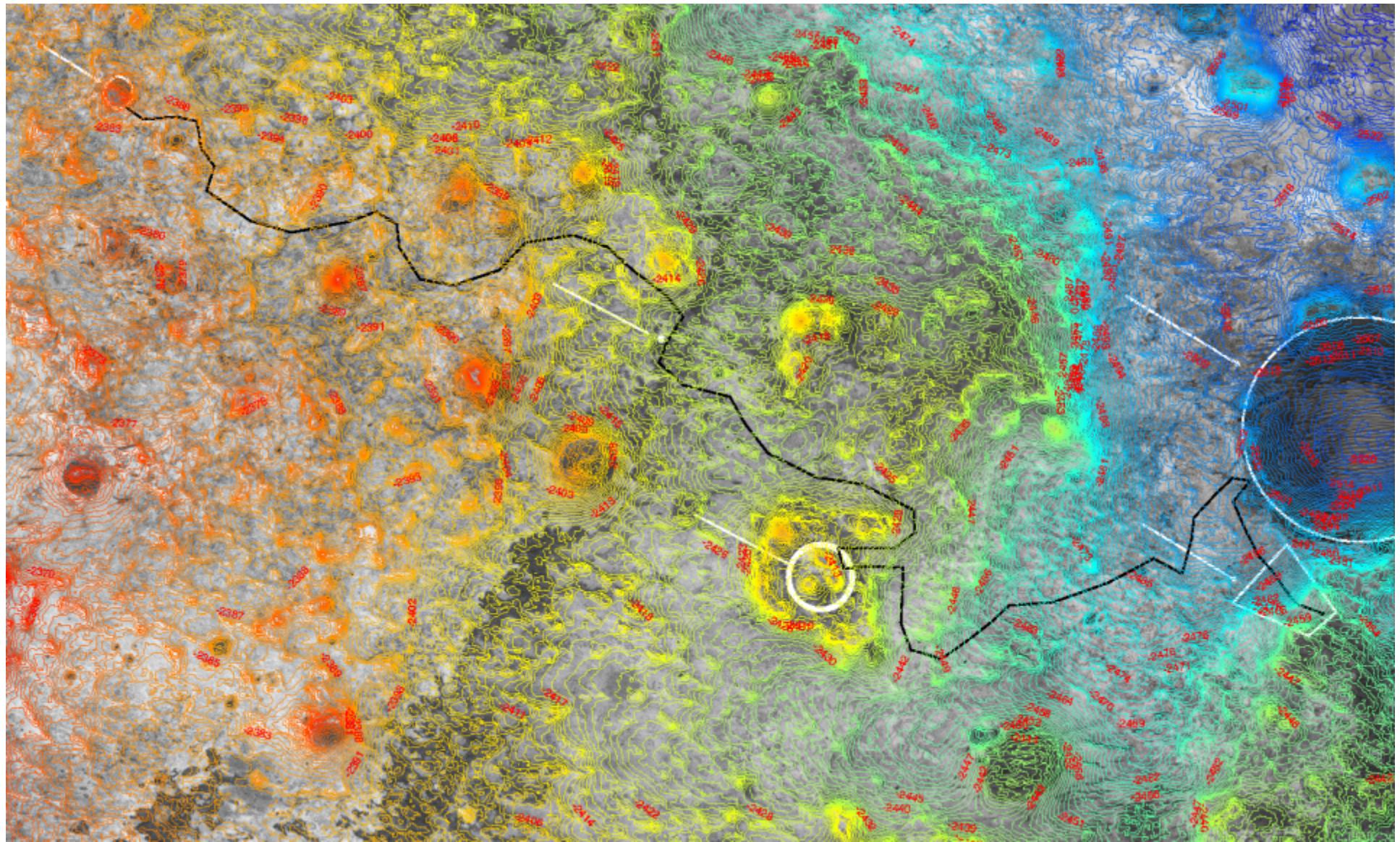
Example of traverse is suggested in the following, with particular targets

Example of traverse



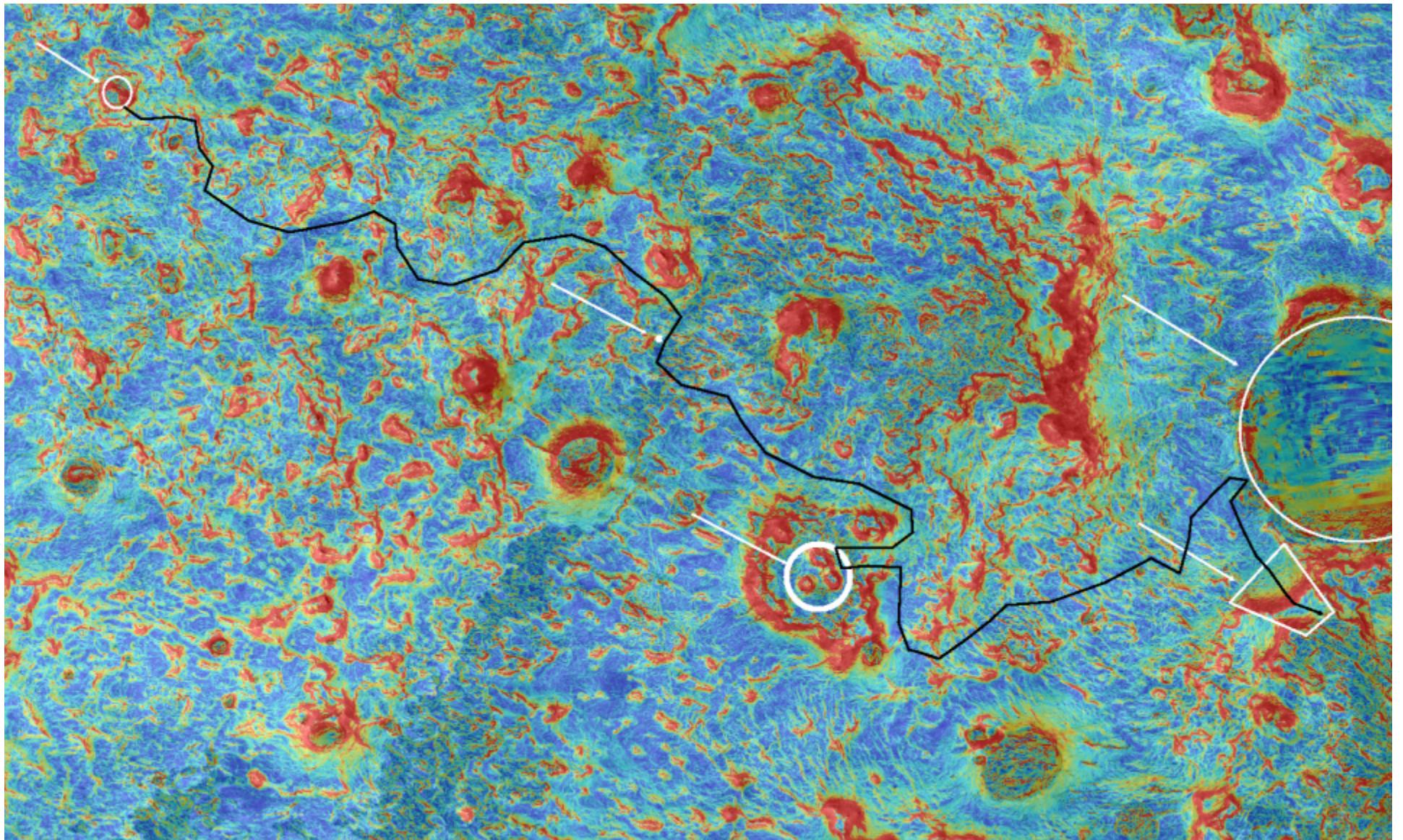


Traverse is 7.8 km long



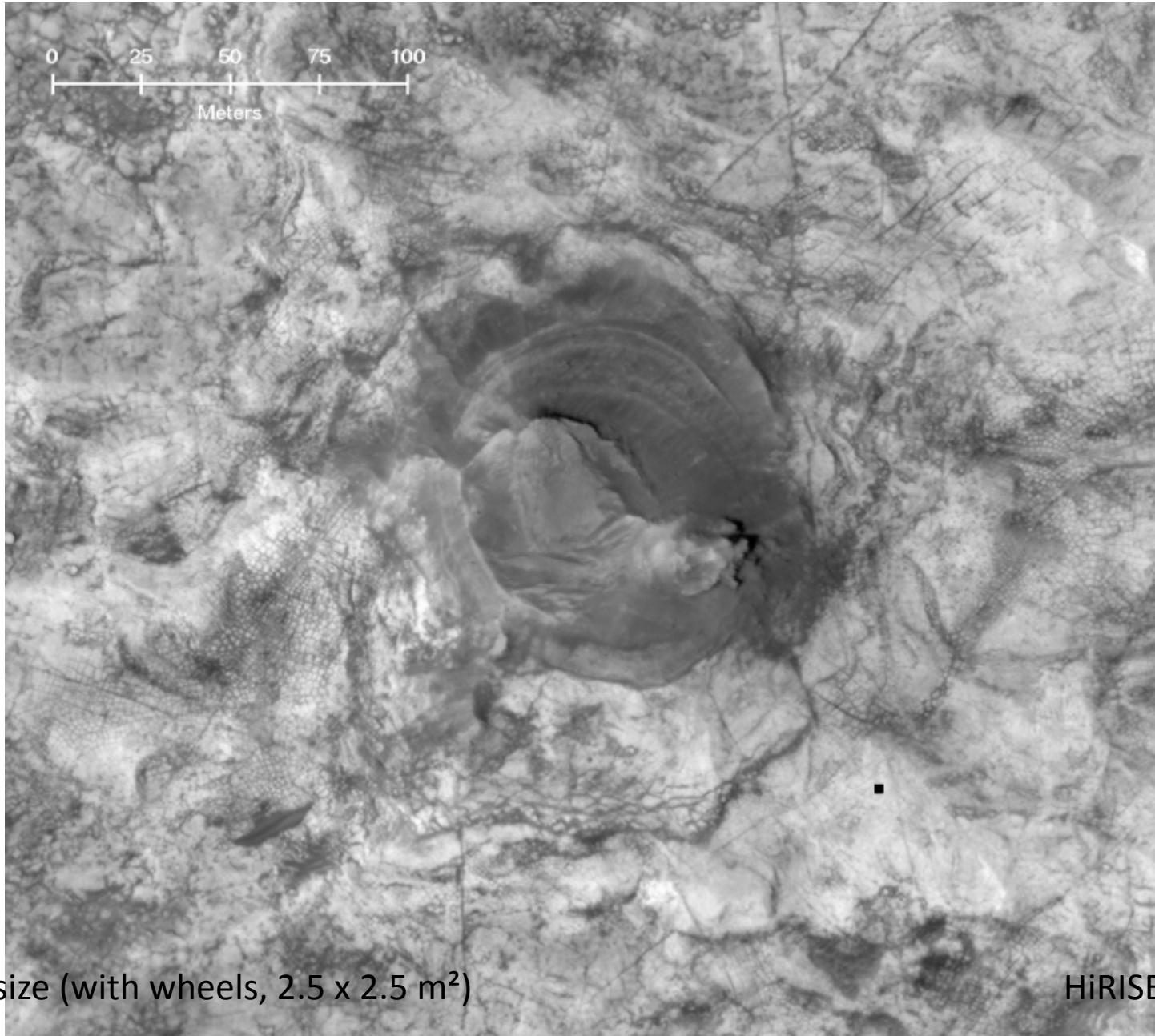
Traverse is 7.8 km long

Difference in altitude: 140 m



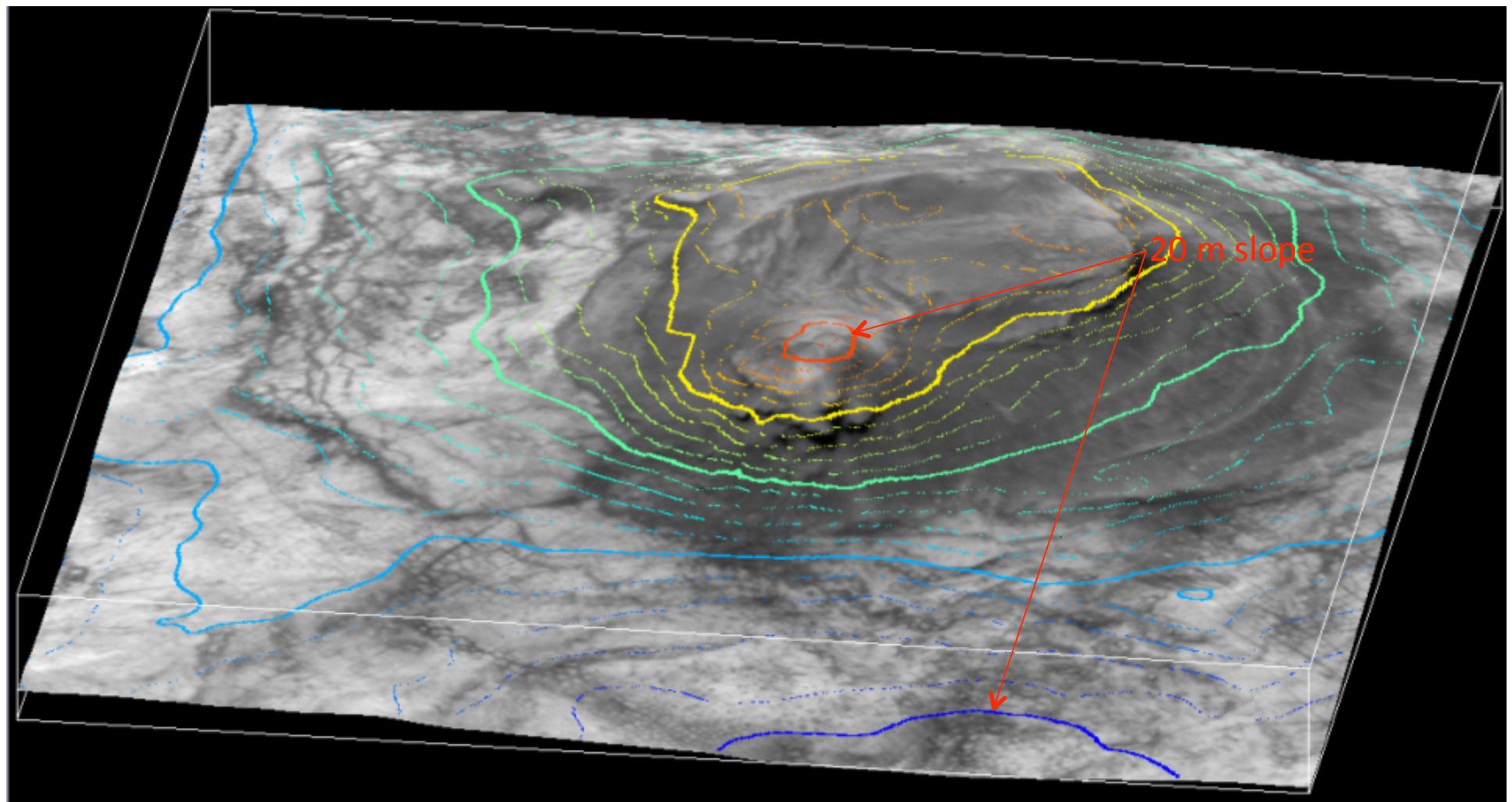
Slope from 0 to 20°, all red is above 20°

Dark layered unit



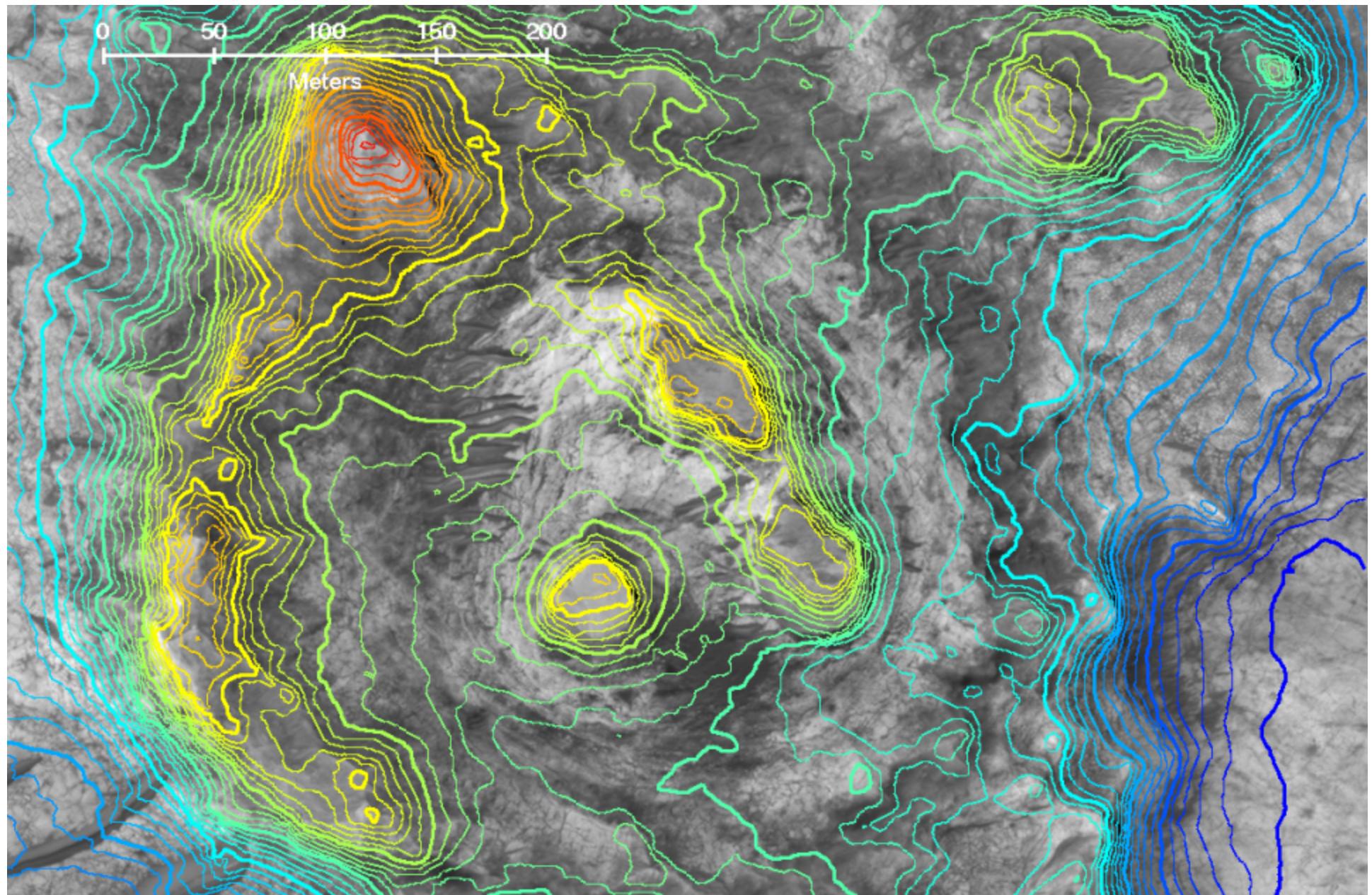
Dark layered unit

No vertical exaggeration
Height contours every 1 m



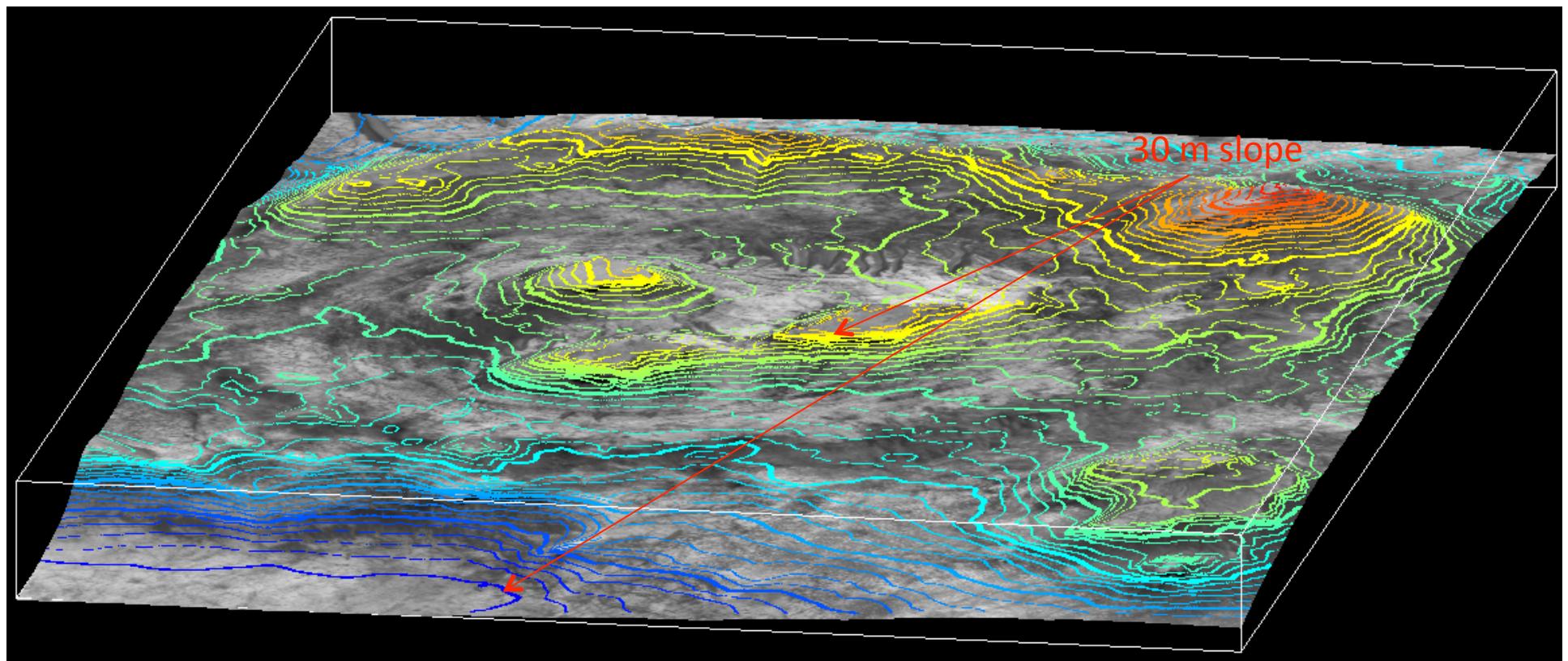
Bright layered unit inside ancient crater

Height contours every 1 m



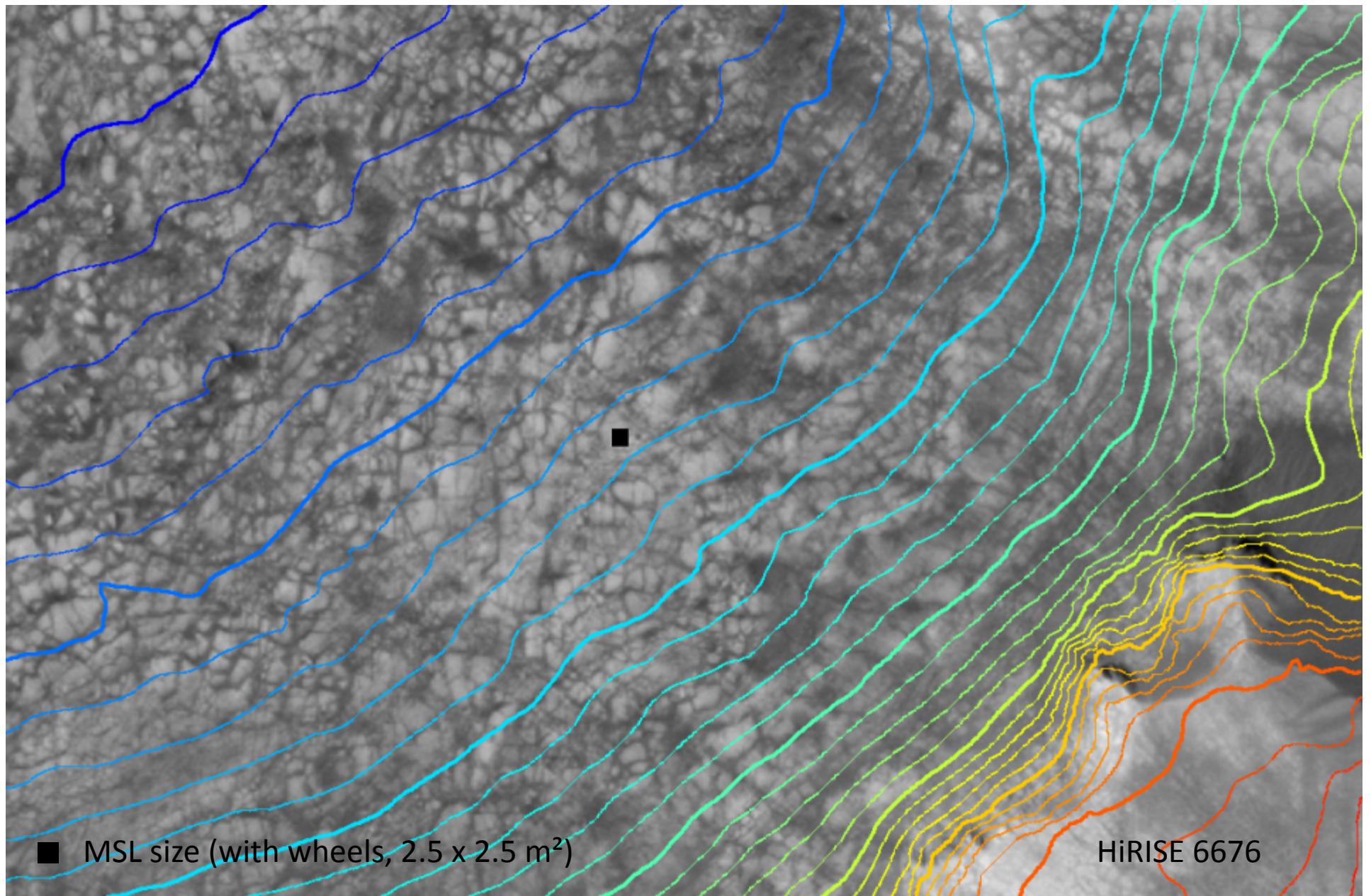
Bright layered unit inside ancient crater

No vertical exaggeration
Height contours every 1 m



Contact between Al- and Fe-phyllosilicate units

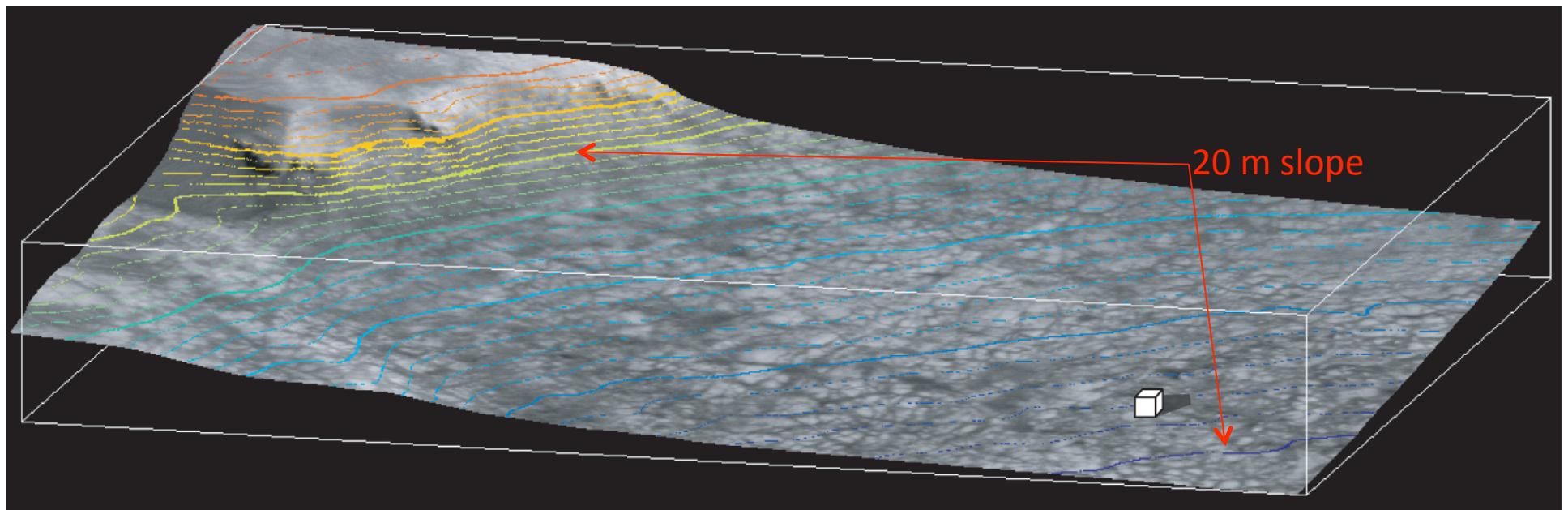
Height contours every 1 m



Contact between Al- and Fe-phyllosilicate units

vertical scale x1

Height contours every 1 m

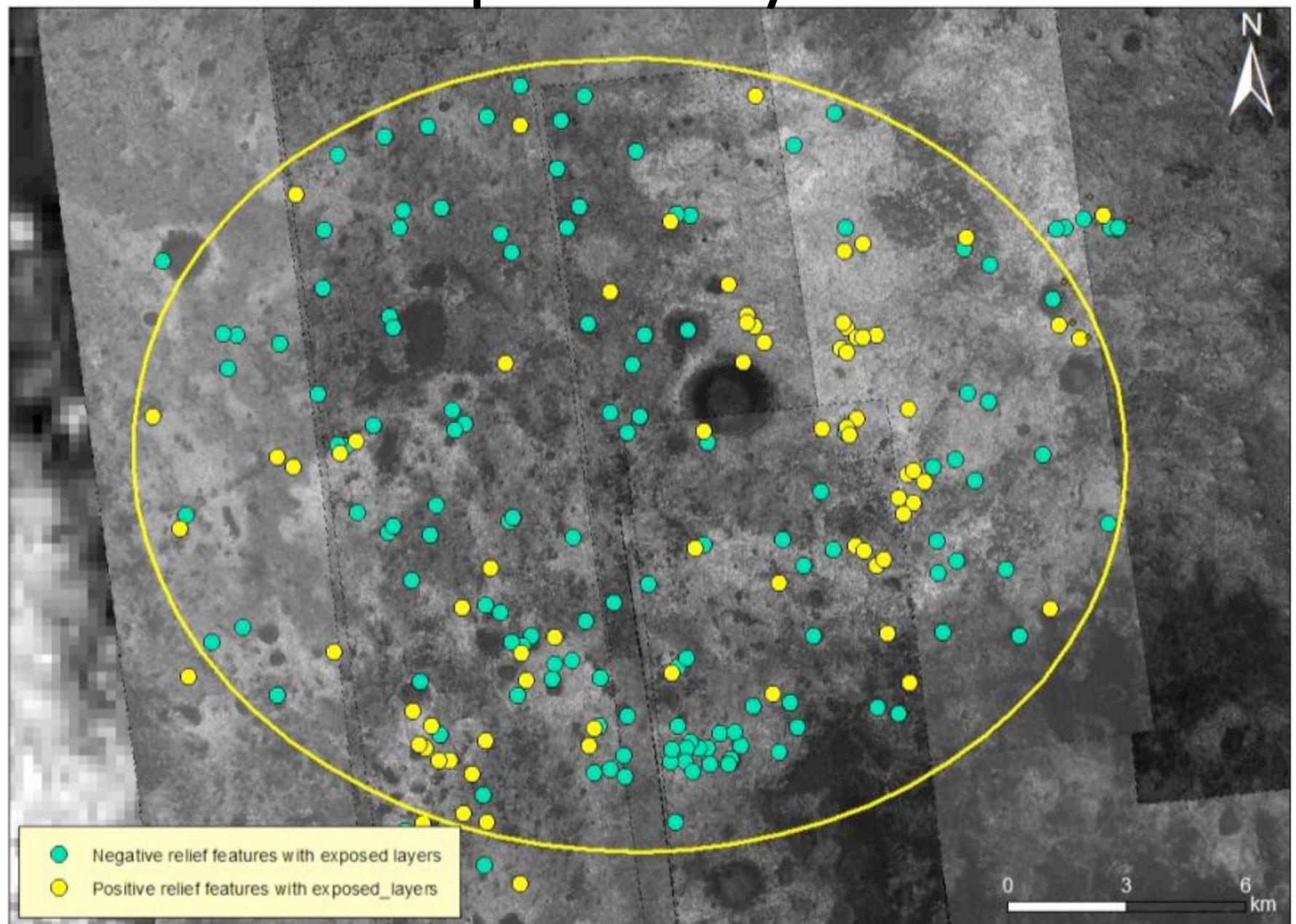


ONE YEAR (and more) at Mawrth Vallis

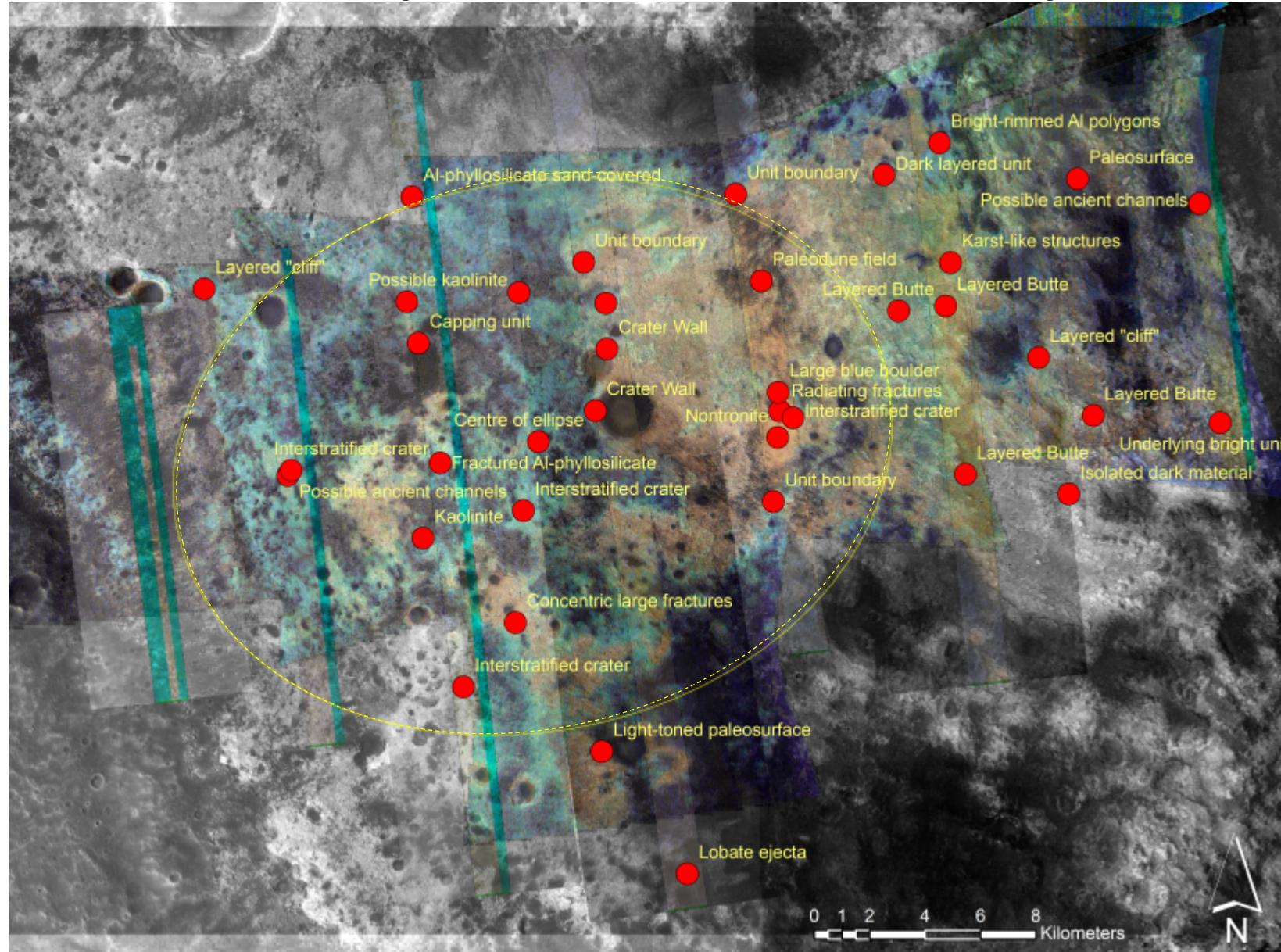
The capability to explore terrains within the entire ellipse, and possibly to expand the traverse out, gives access to structures and samples recording Mars History from the early Noachian.

A large number of specific sites have already been identified remotely, some described hereafter, either representative of the large units, or unique features.

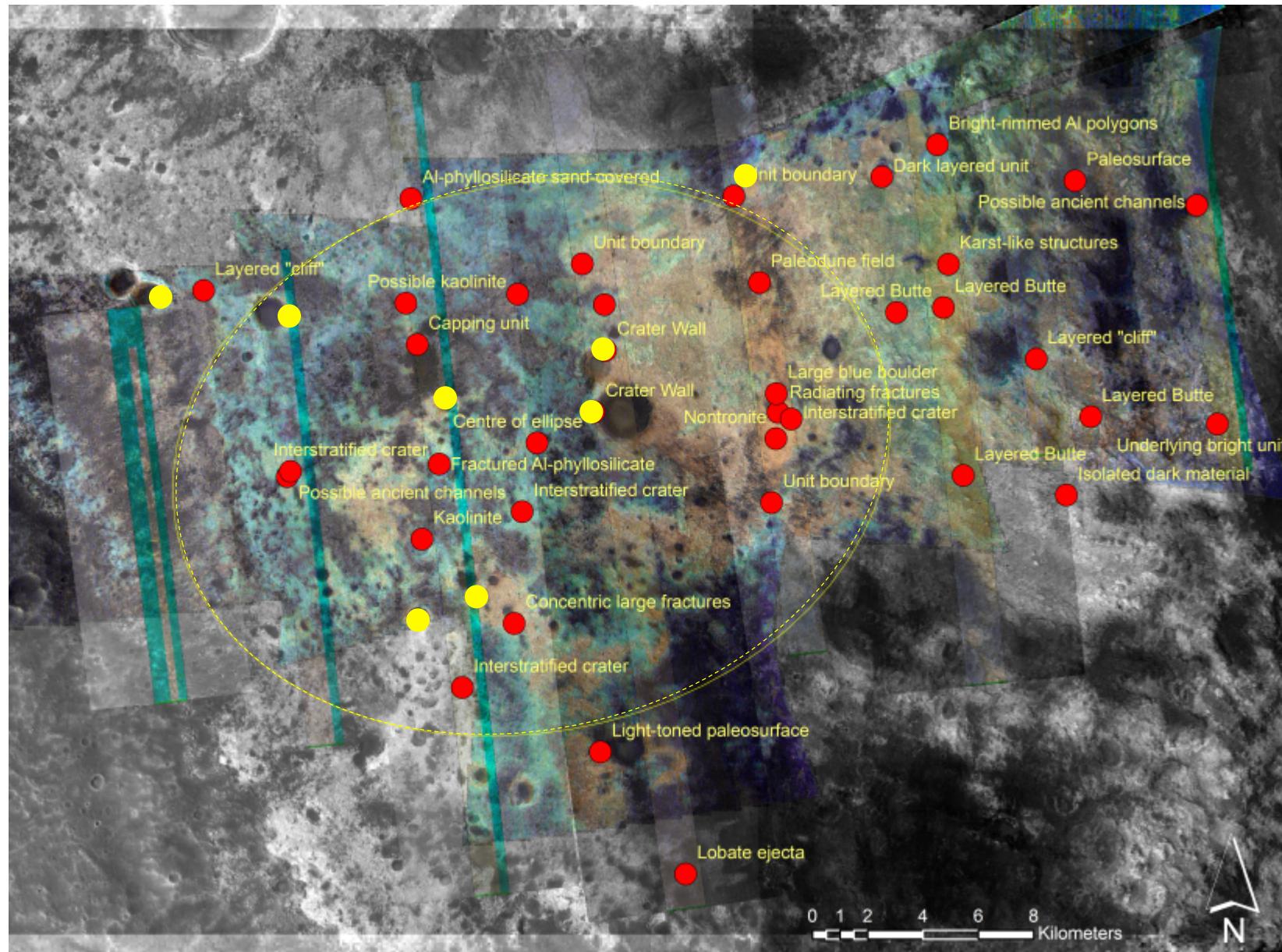
Exposed layers



Most representative/unique sites

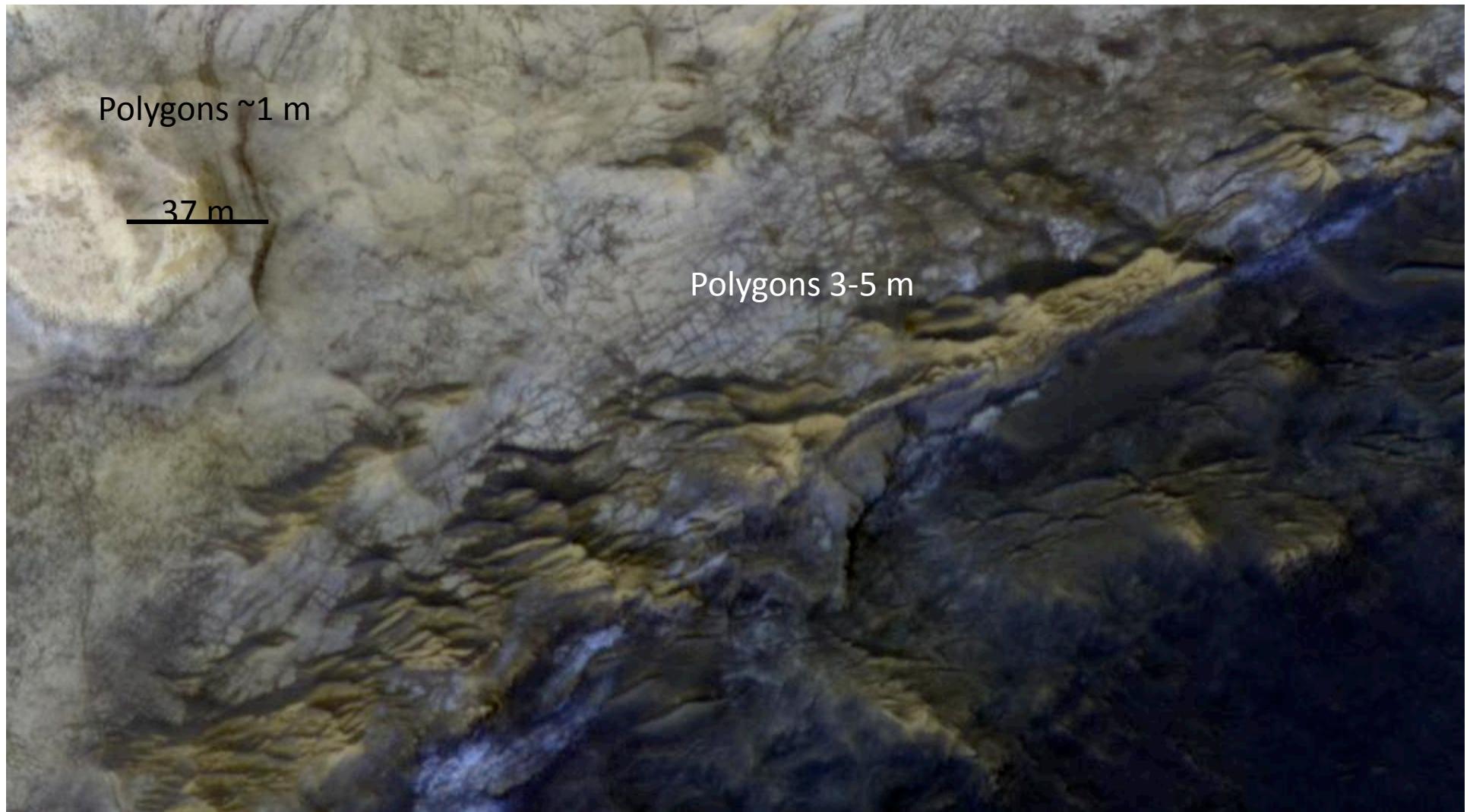


Crater Walls



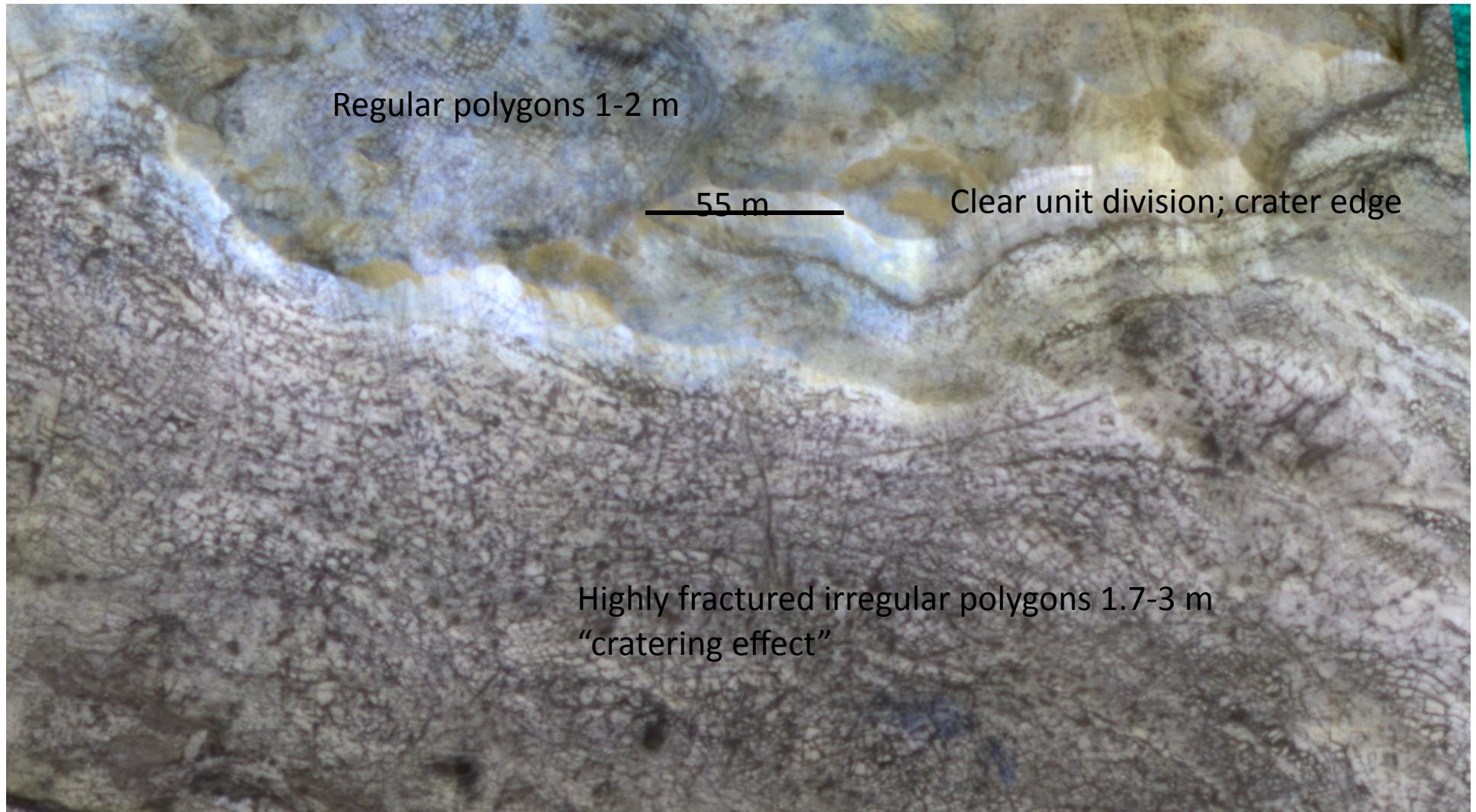
Crater Walls

PSP_005964_2045

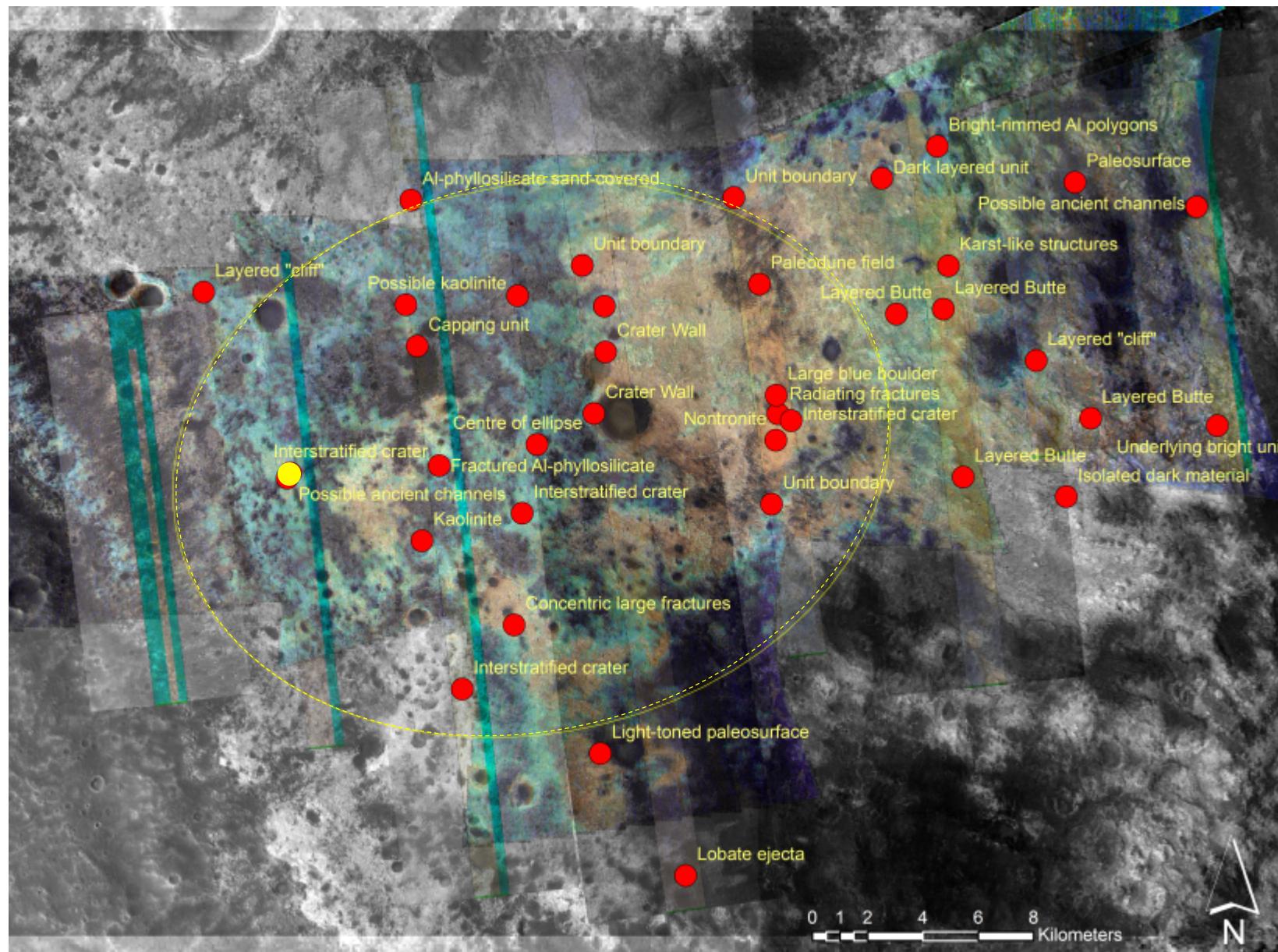


Crater Walls

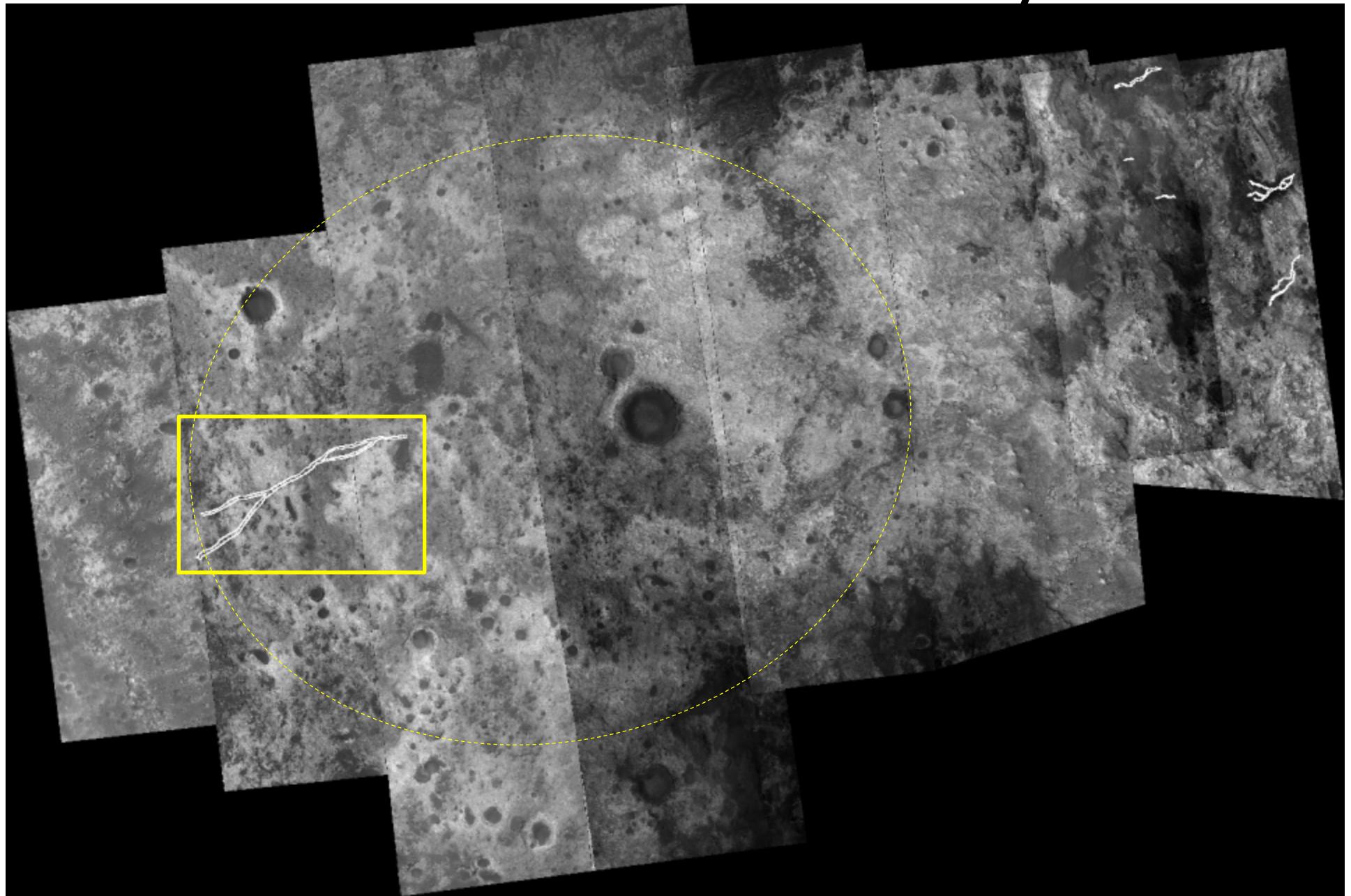
PSP_005964_2045



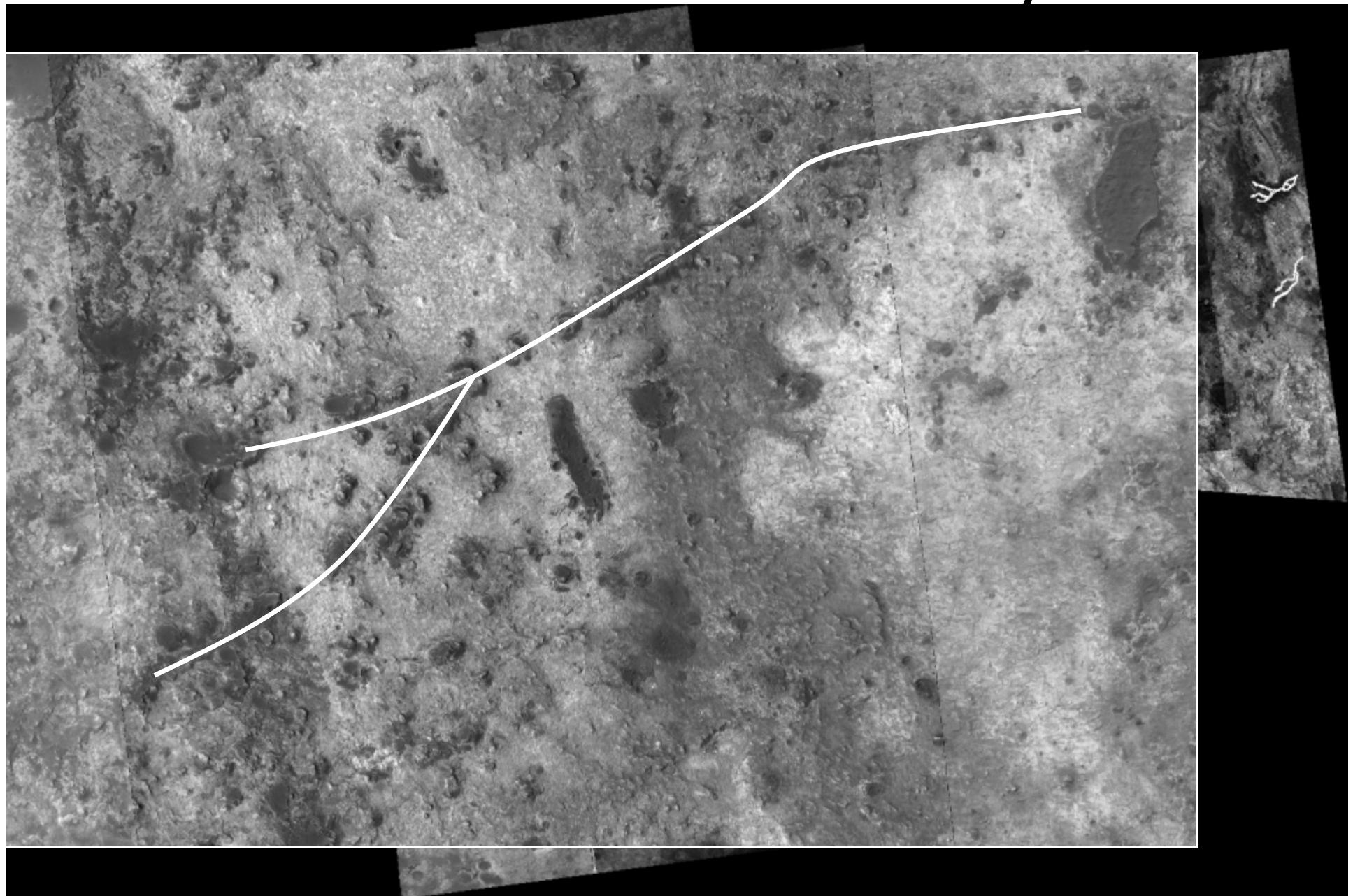
Possible ancient valley



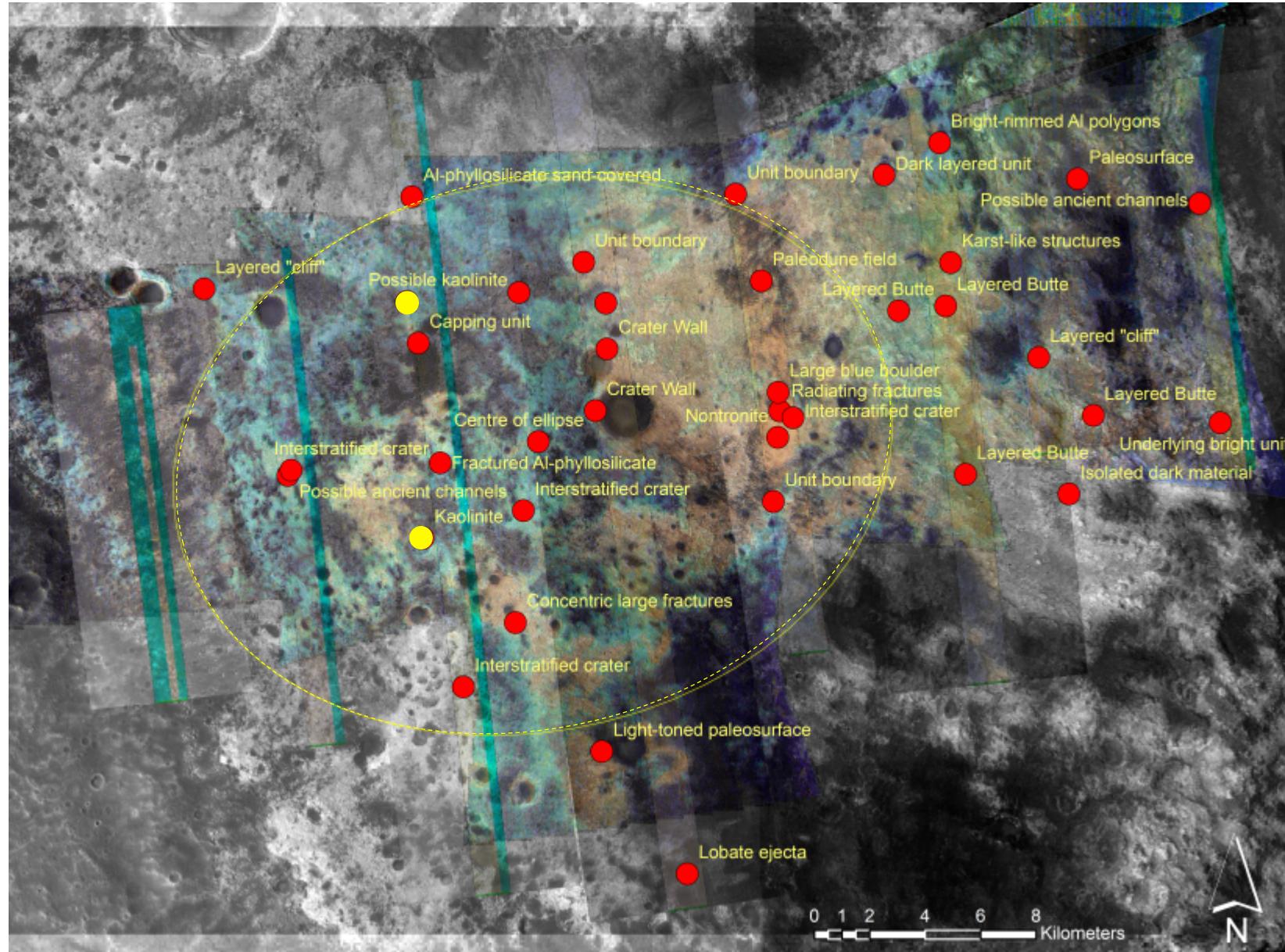
Possible ancient valley



Possible ancient valley



Kaolinite detection



Kaolinite detection

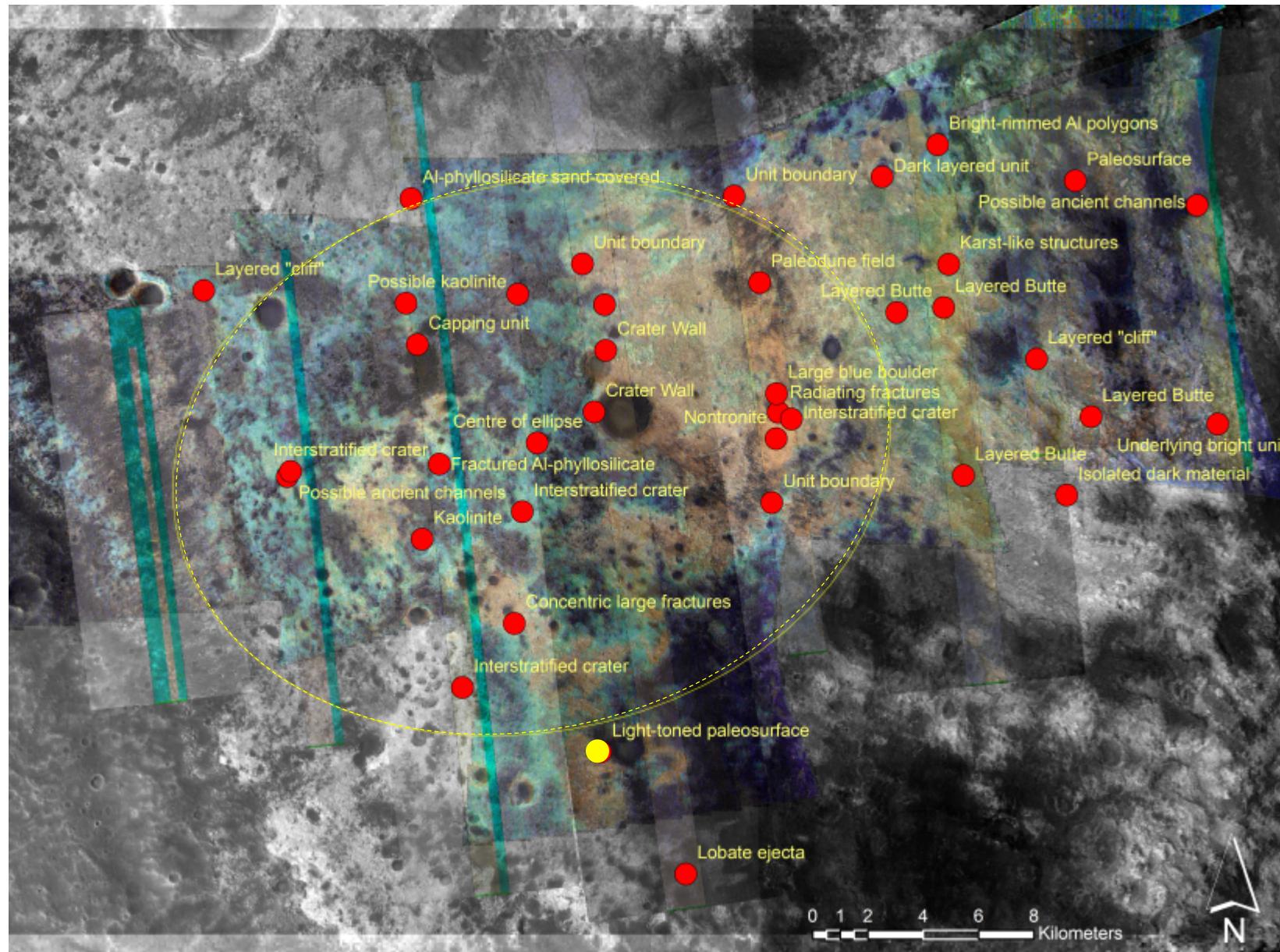
PSP_008825_2040



Very bright, irregularly fractured material

42 m

Cratered surface

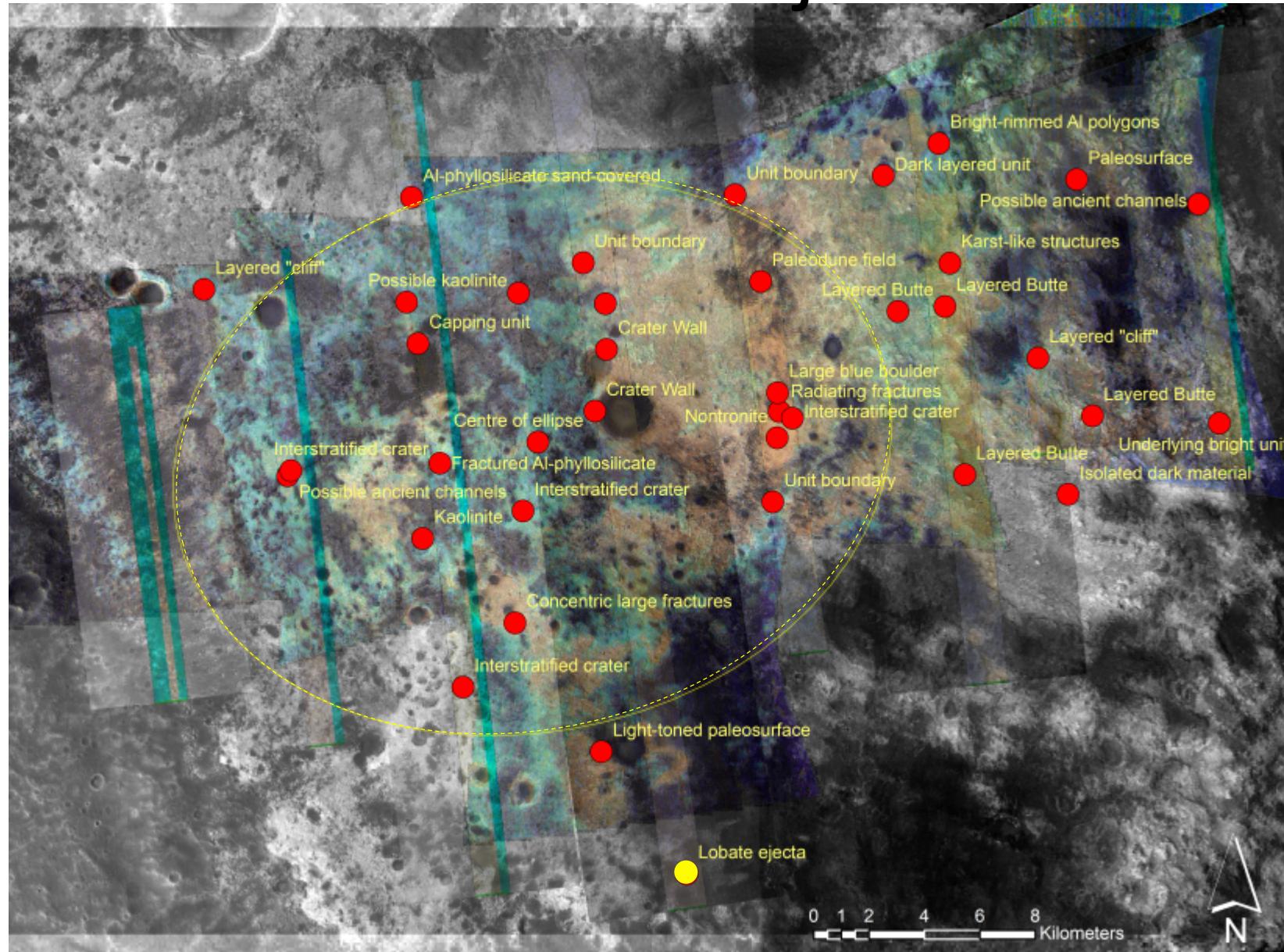


Cratered surface

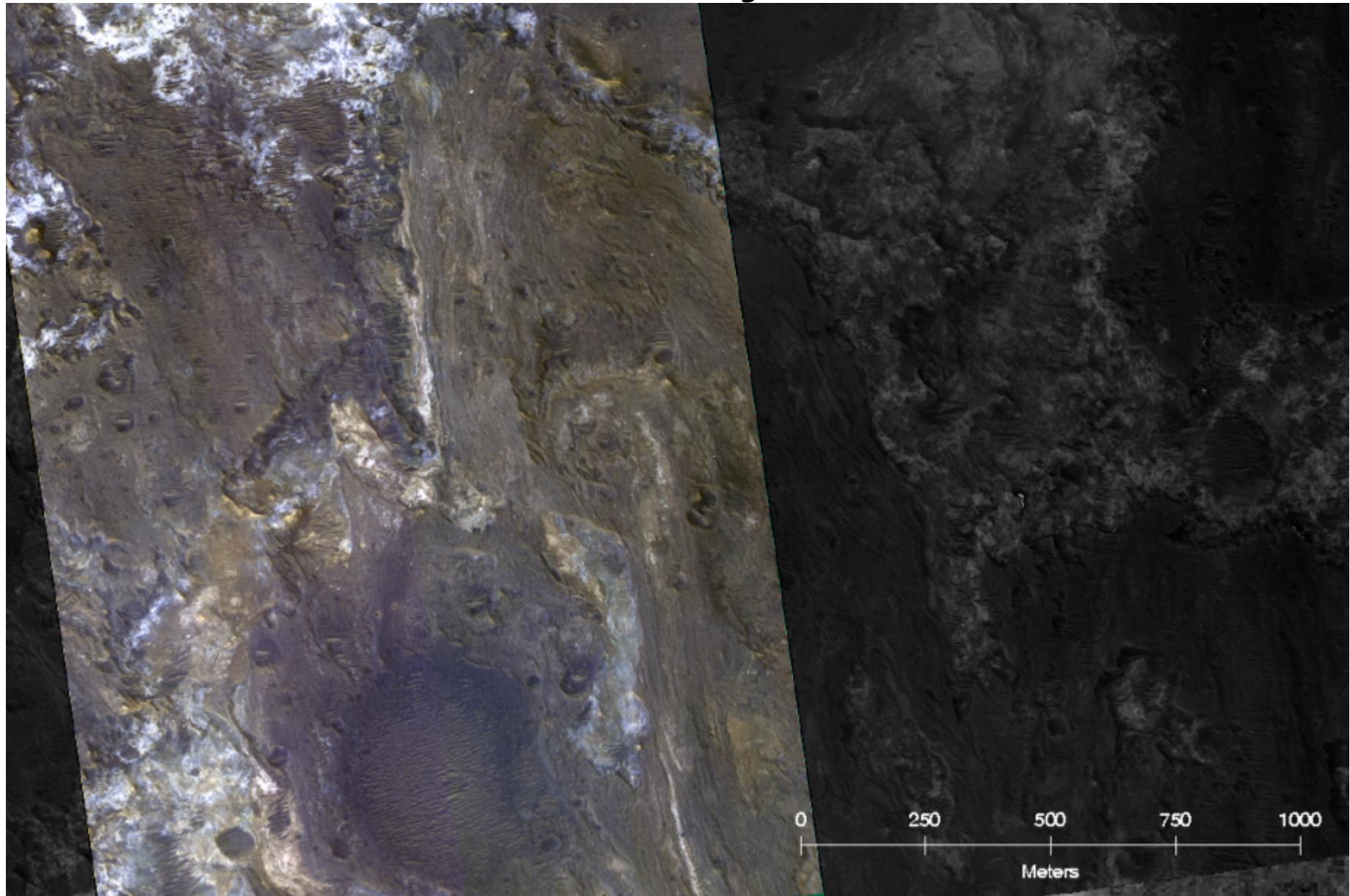


This is like the “paleosurface”, saturated in filled craters, but only with light toned rocks, not seen it anywhere else.

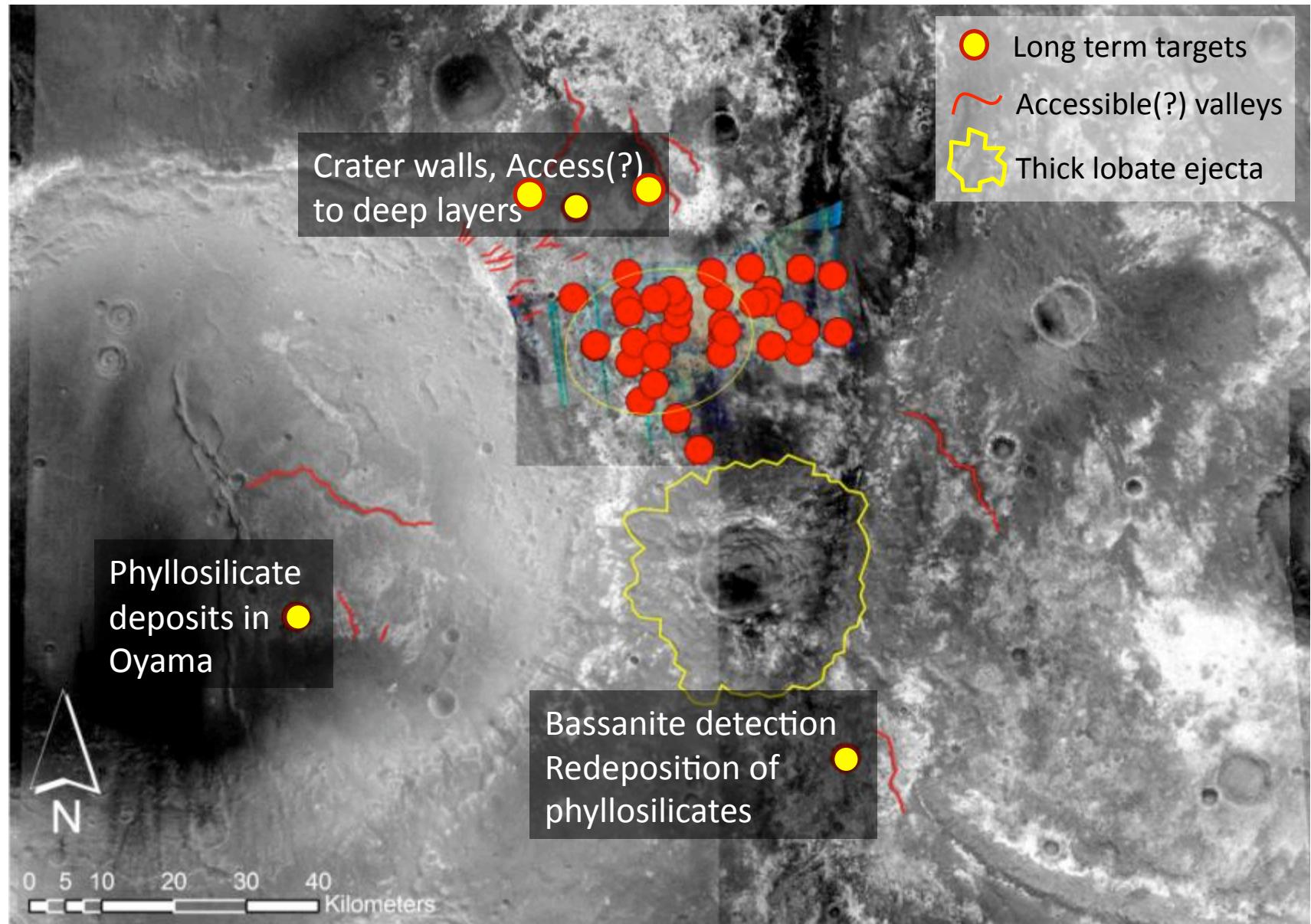
Lobate ejecta



Lobate ejecta



Long term targets



Long term targets: crater walls near ellipse



MANY TARGETS...

In ellipse targets:

- layers in crater walls, buttes, filled craters, scarps
- different compositional units
- different polygonal textures
- large fractures
- ancient valleys

Near ellipse:

- paleosurfaces
- lobate ejecta
- pitted and etched terrain
- possible sulfates

Long term targets:

- deeper craters
- phyllosilicates redeposits
- many valleys

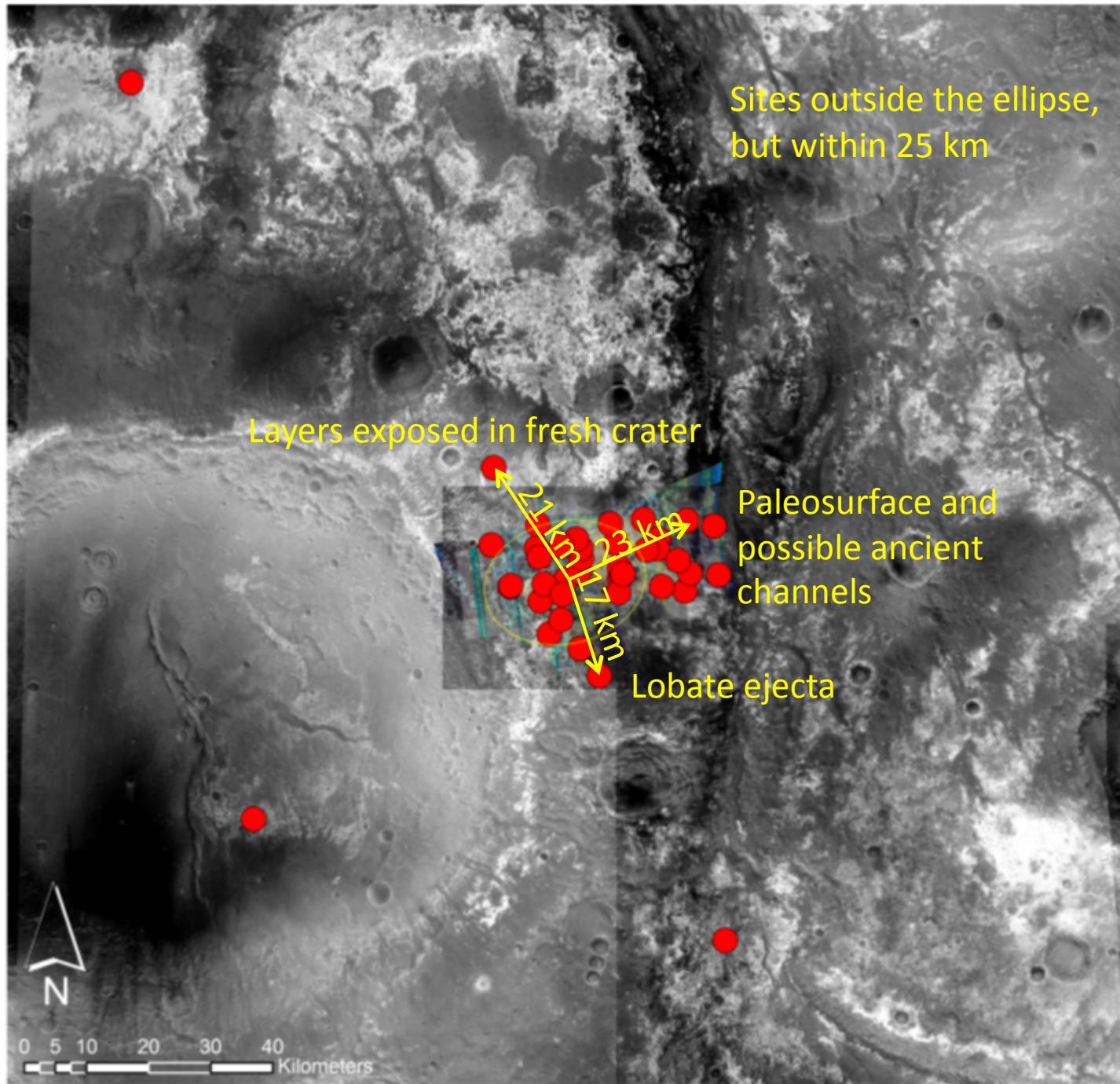
...LOTS OF WORK FOR MSL!

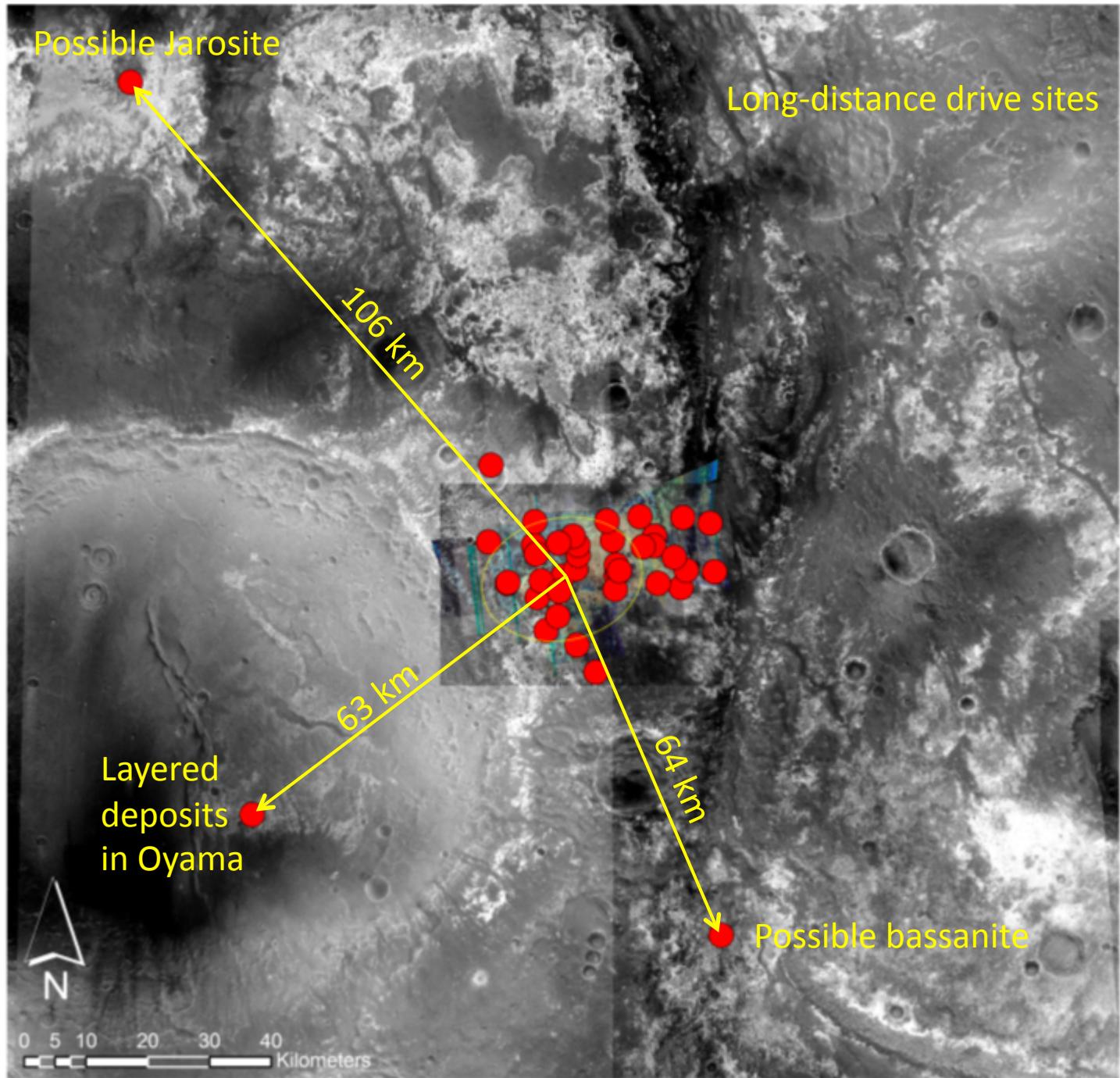
Additional slides...

ONE YEAR (and more) at Mawrth Vallis

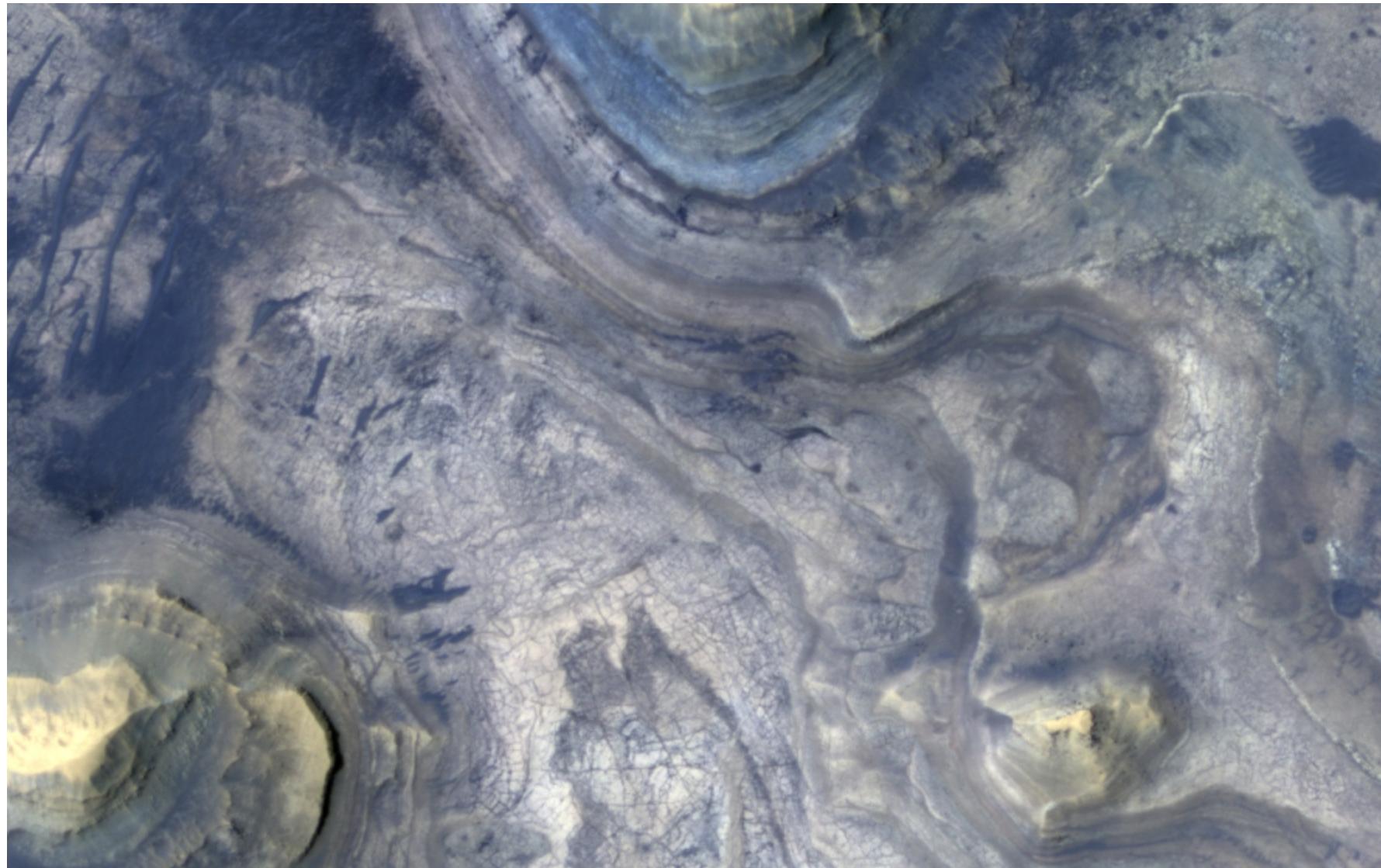
With the unprecedented analytical capability of MSL, the exploration of the Mawrth Vallis site will insure to characterize, for the first time, the ancient Mars History through terrains and samples kept in place, within the context of their formation, preserving the best record of the evolution of Mars, in particular with respect to the role water may have played.

There is a perfect fit between the MSL goals and capabilities on one side, the Mawrth Vallis site on the other.





Oyama crater floor deposits



Hydrated sulfates in the bend of Mawrth Vallis (bassanite)

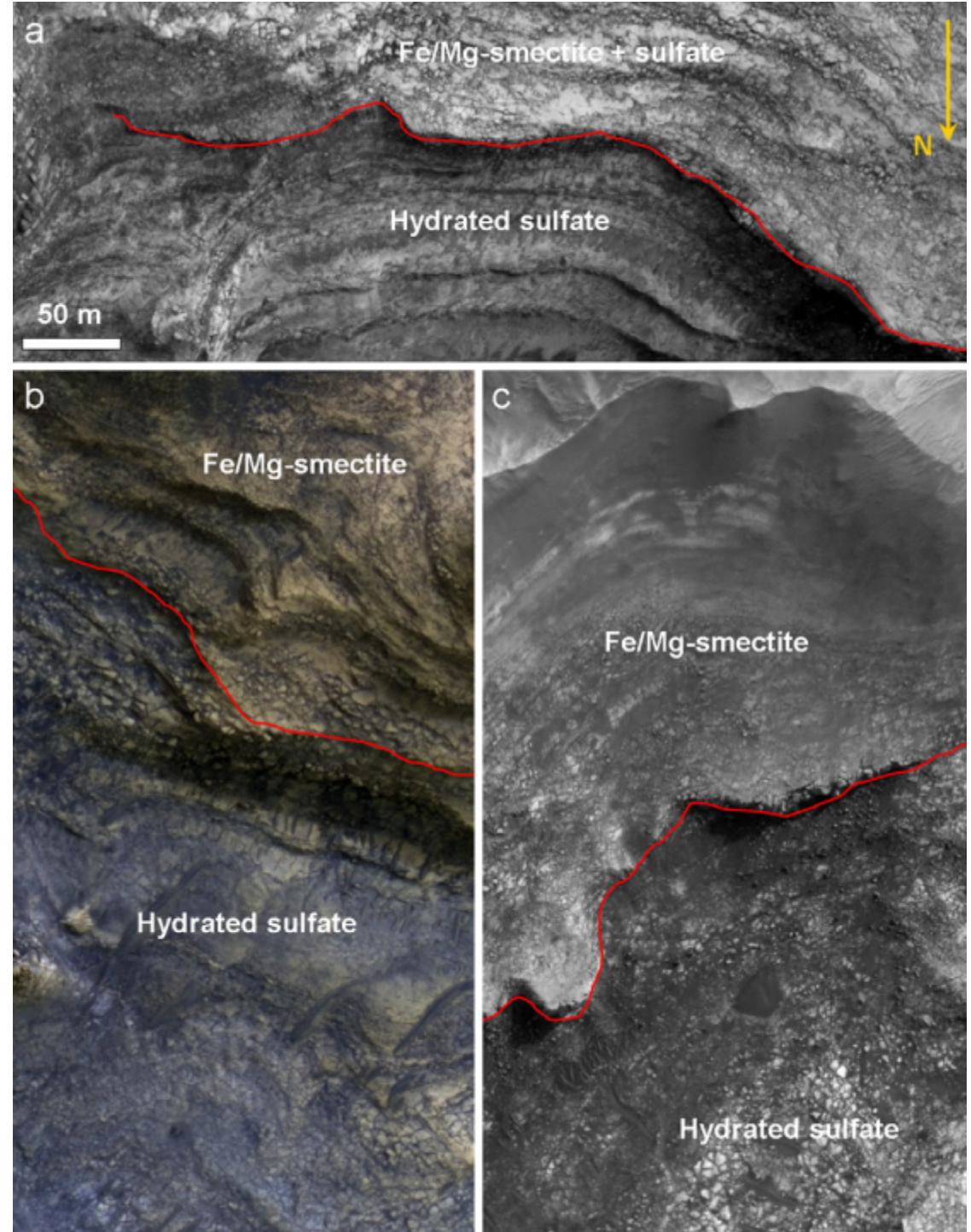
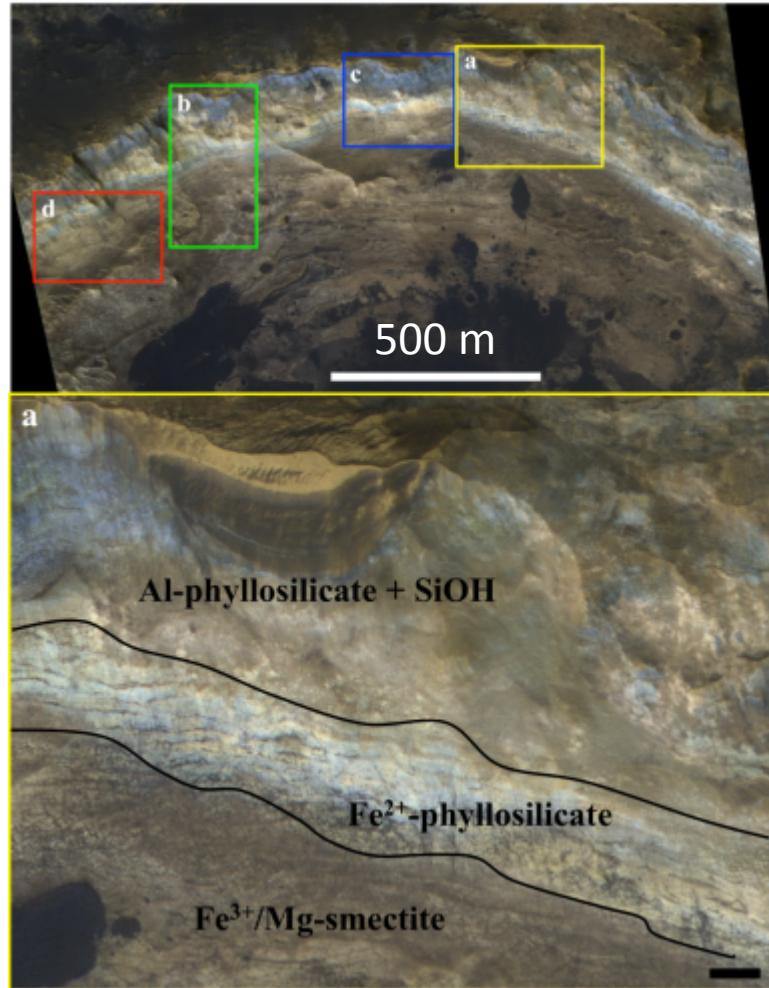


Fig. 3 from Wray et al. 2010

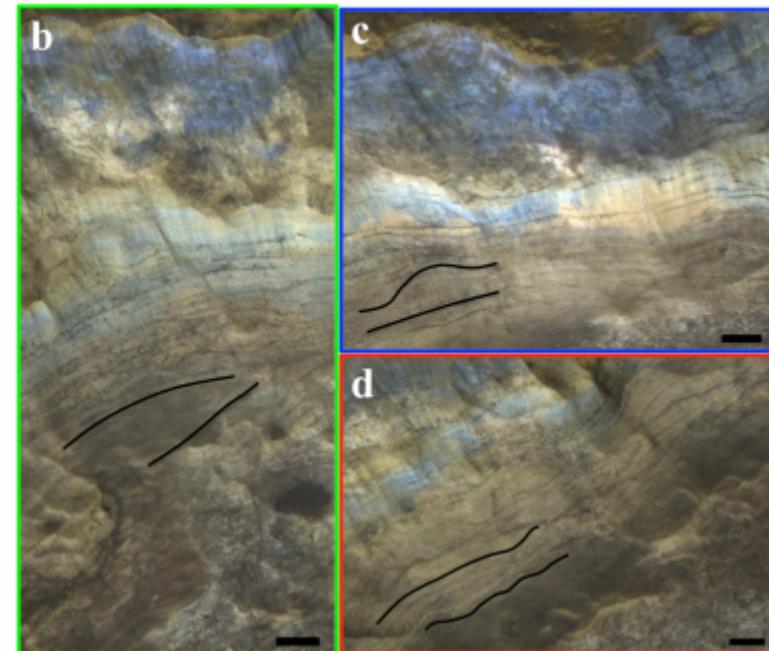
Specific sites: Crater near ellipse



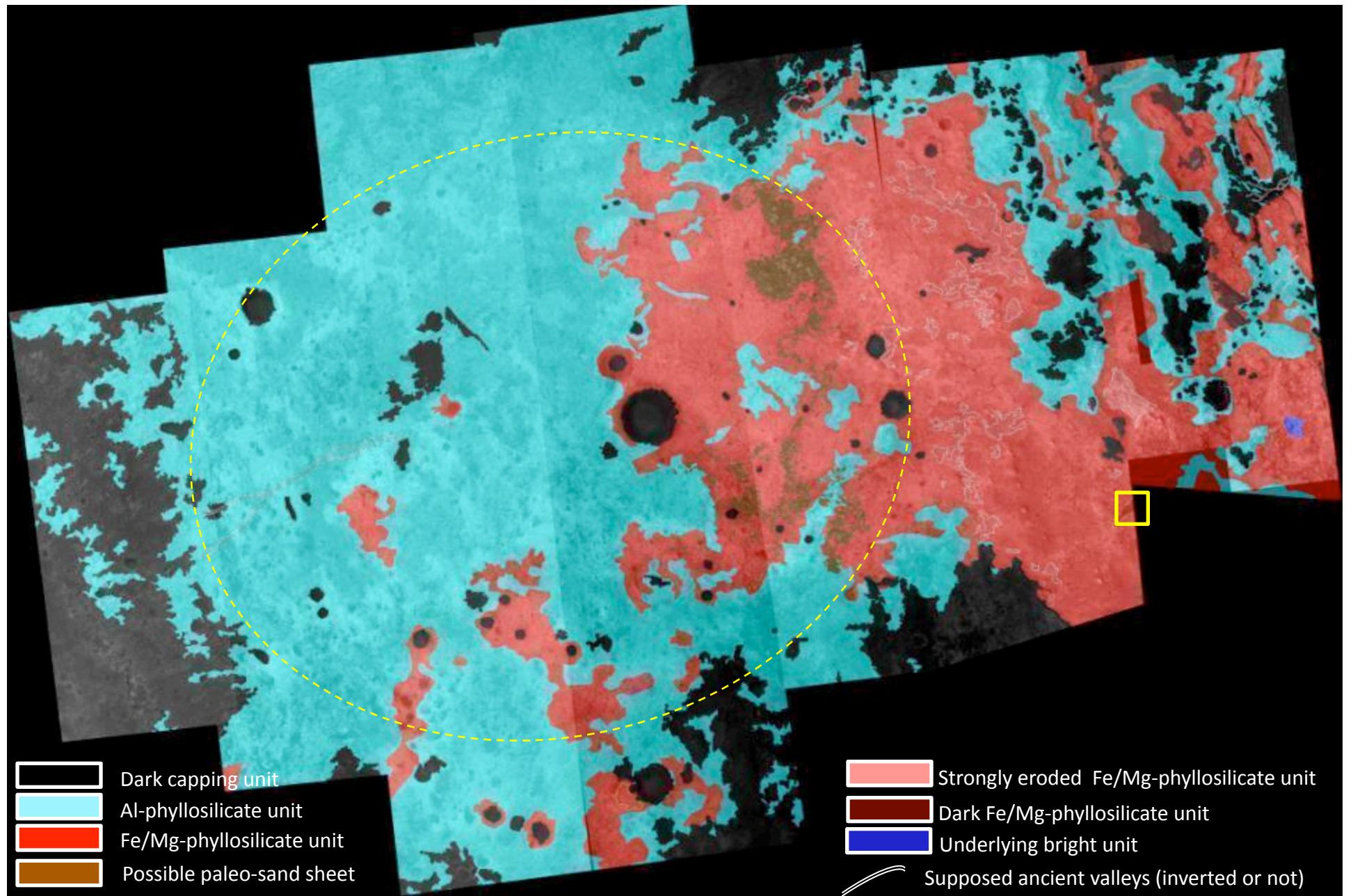
HiRISE mosaic (PSP_004052 and ESP_012873) showing phyllosilicate outcrops in crater wall.

(a) view of Al-phyllosilicate and hydrated silicate material on top, the band of Fe²⁺ material that is likely also a phyllosilicate, and the nontronite below.

(b)(b, c, d) views of unconformity features in beds of nontronite unit (25 m scale bar).



Isolated dark material



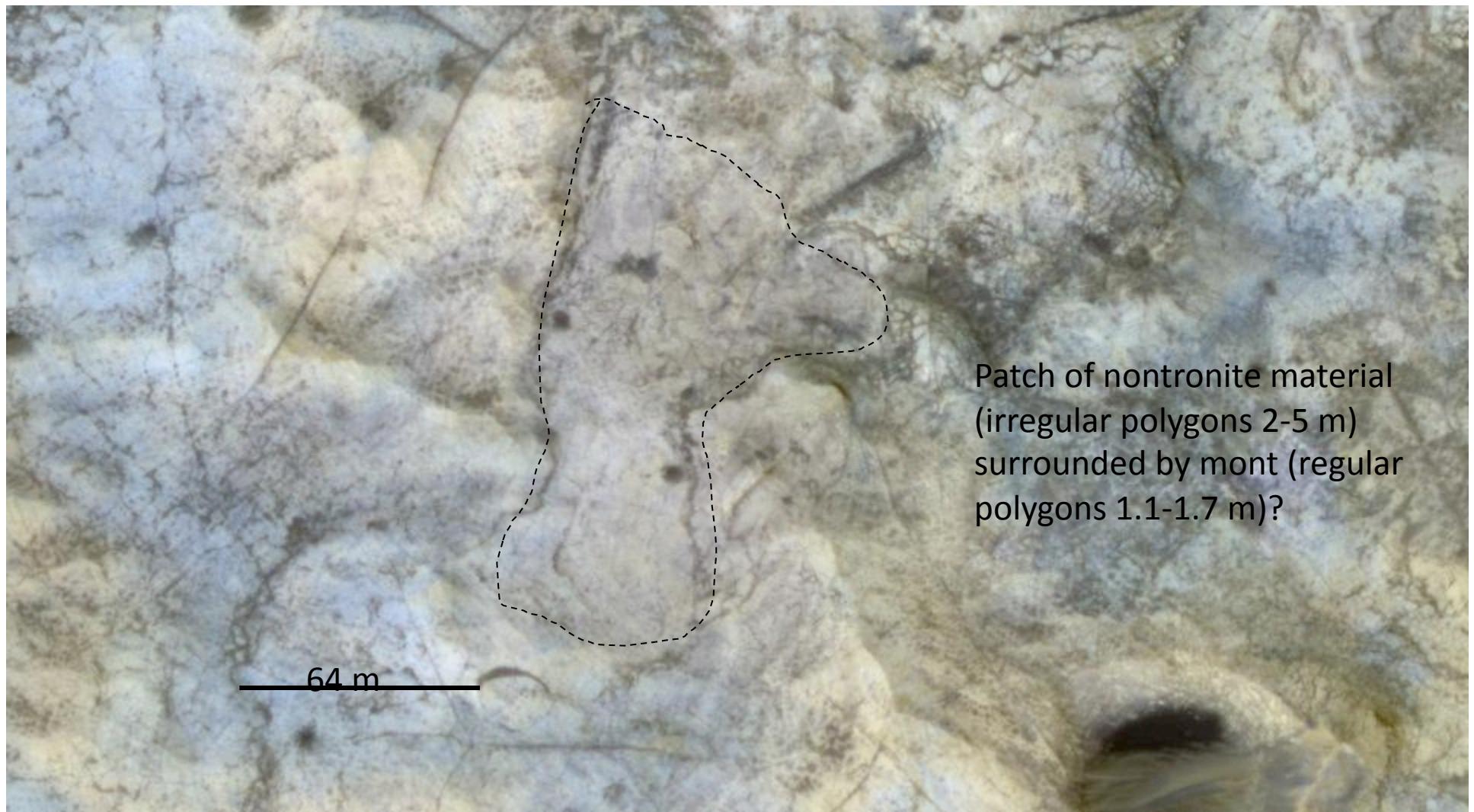
Isolated dark material



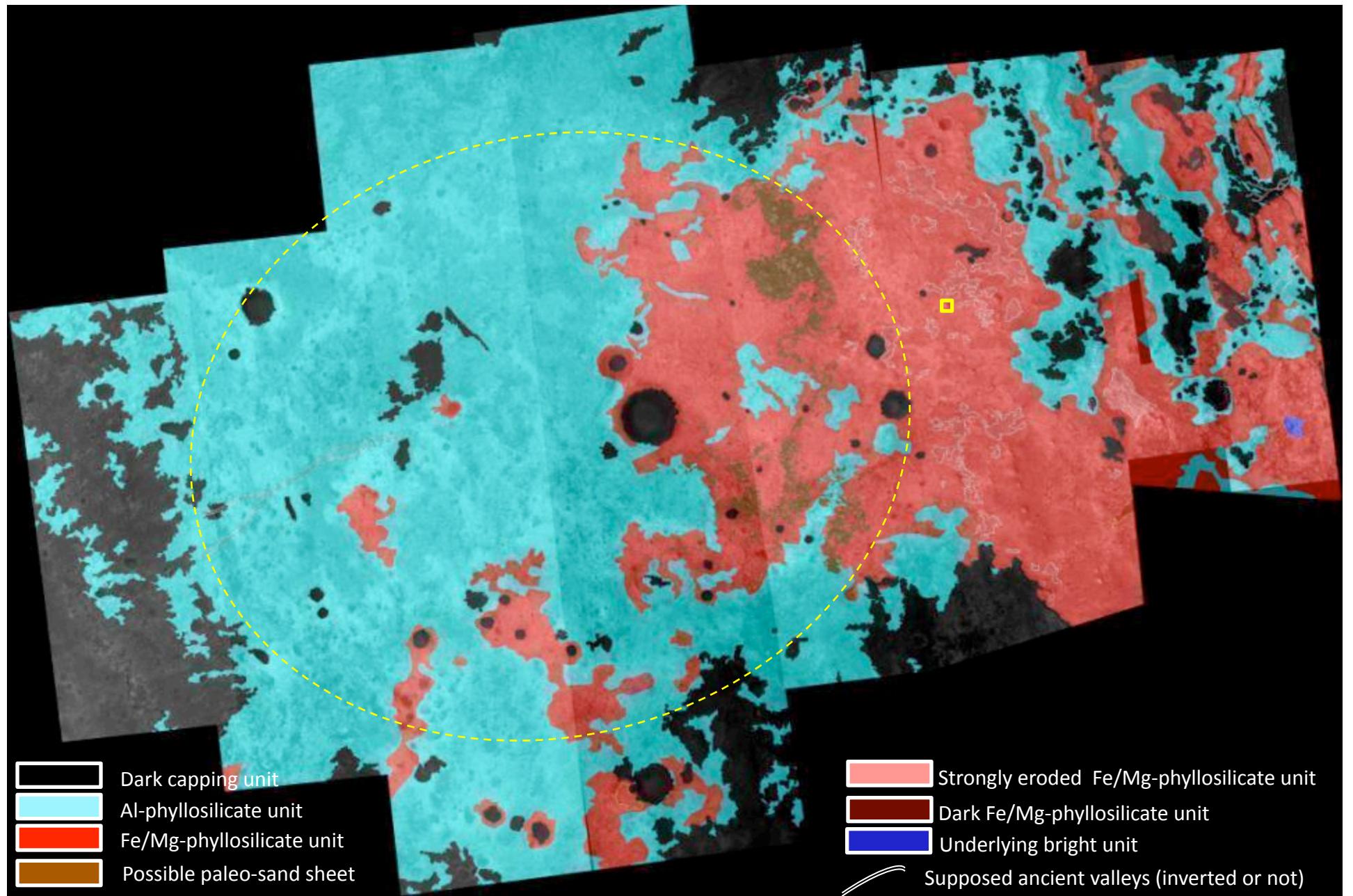
What could this be? From an ejecta? There is nothing similar closeby.

Unit boundary

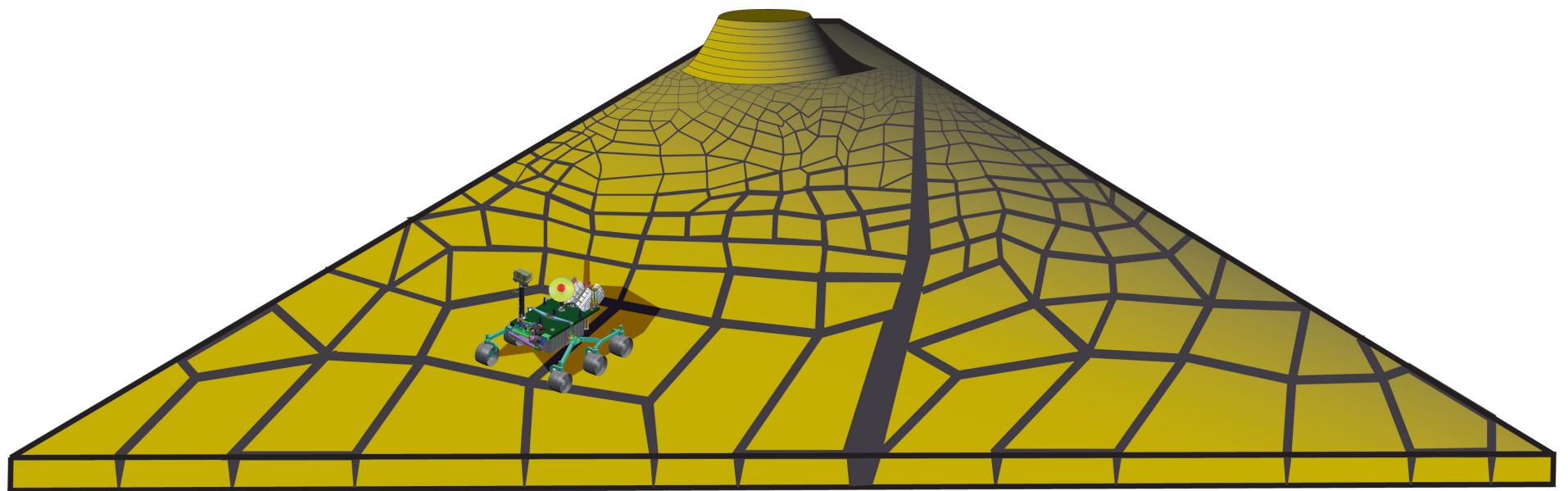
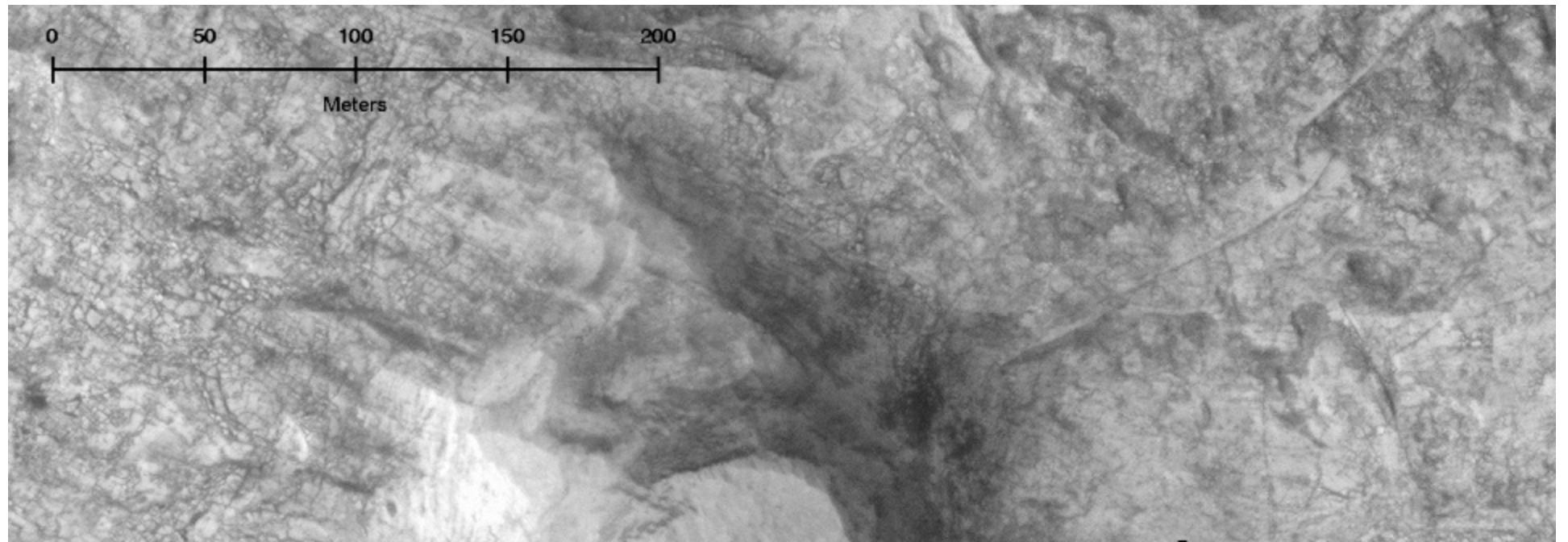
PSP_005964_2045 (5)



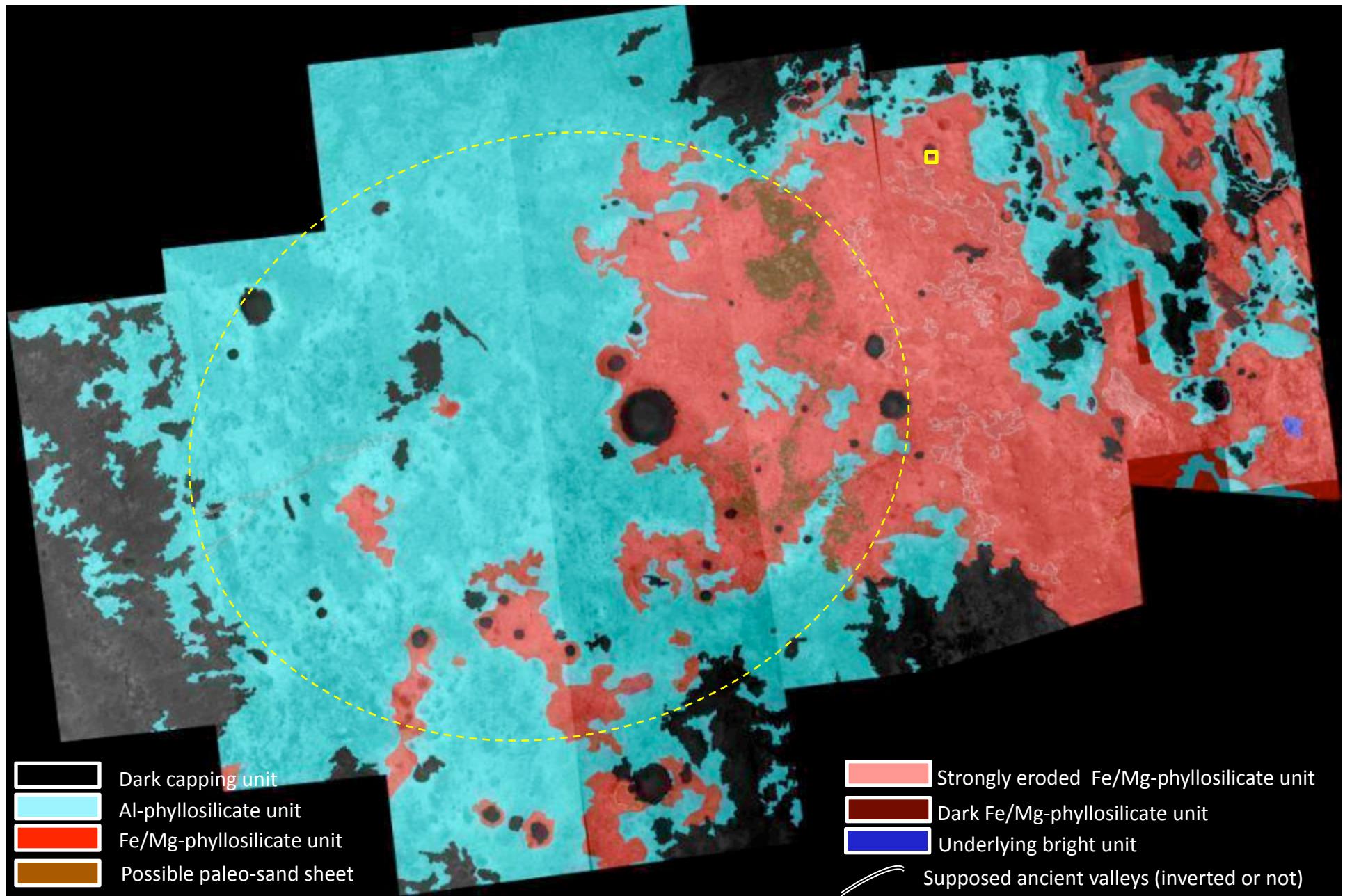
Layered residual buttes



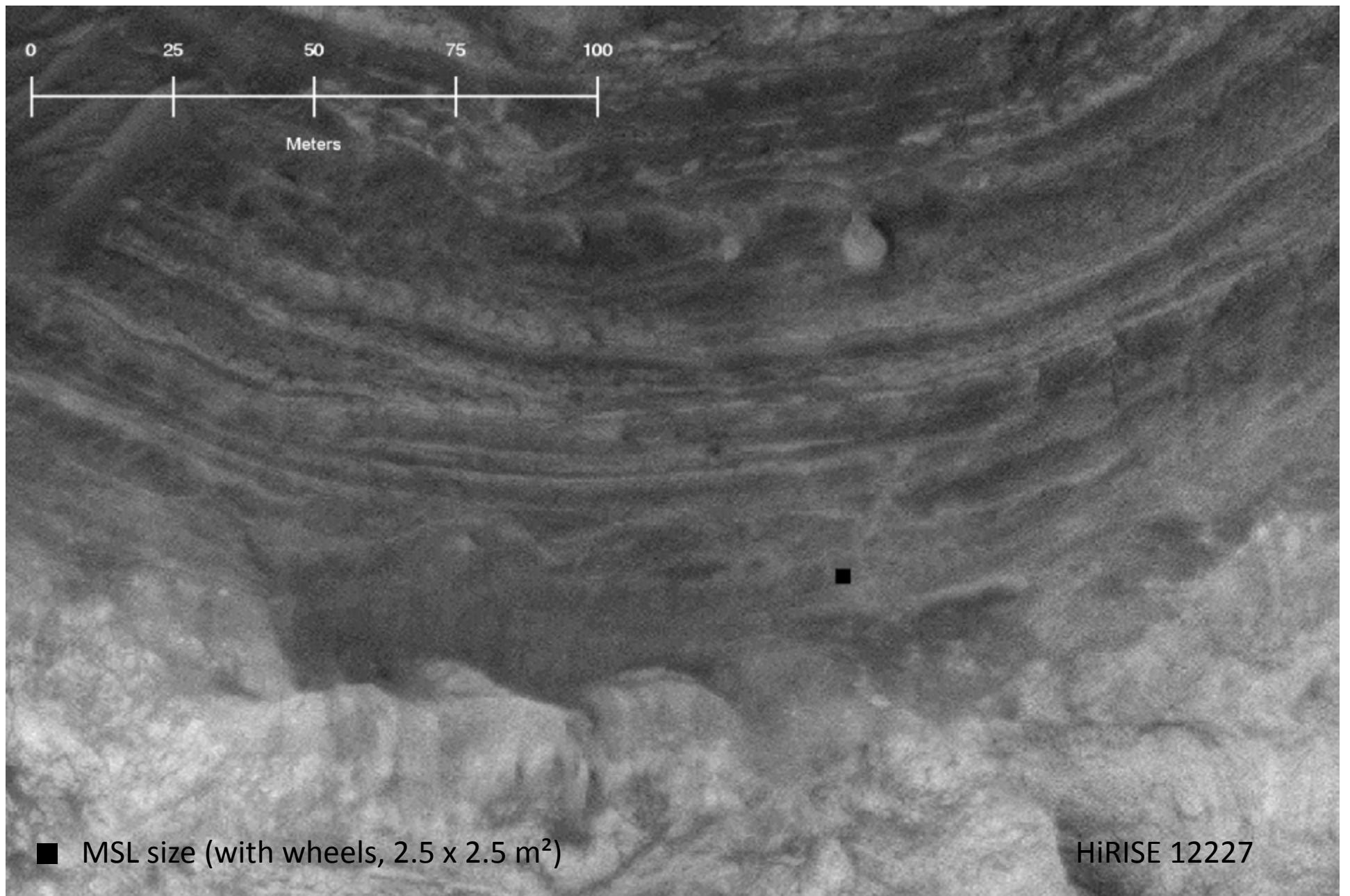
Layered residual buttes



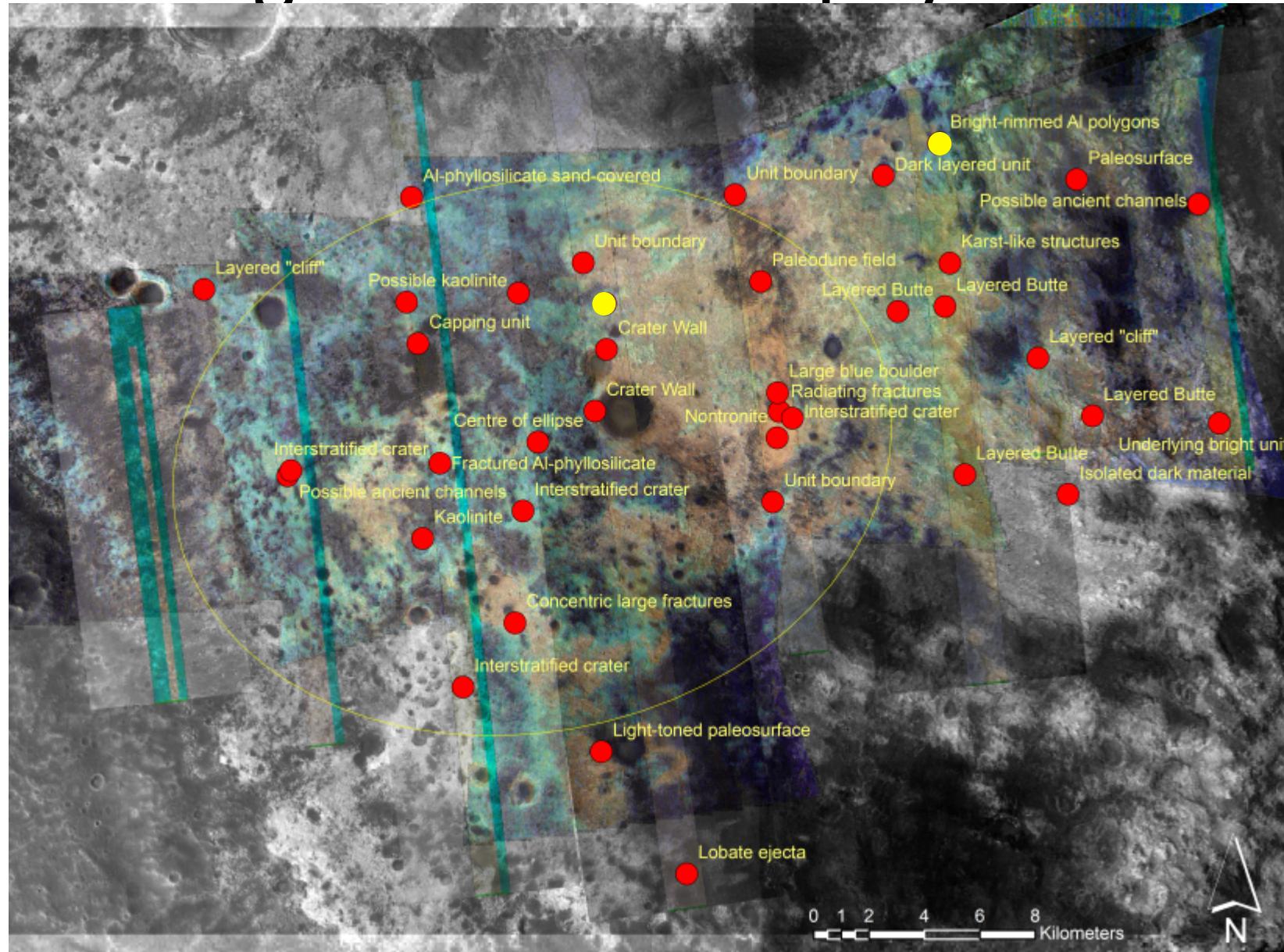
Dark layered unit



Dark layered unit

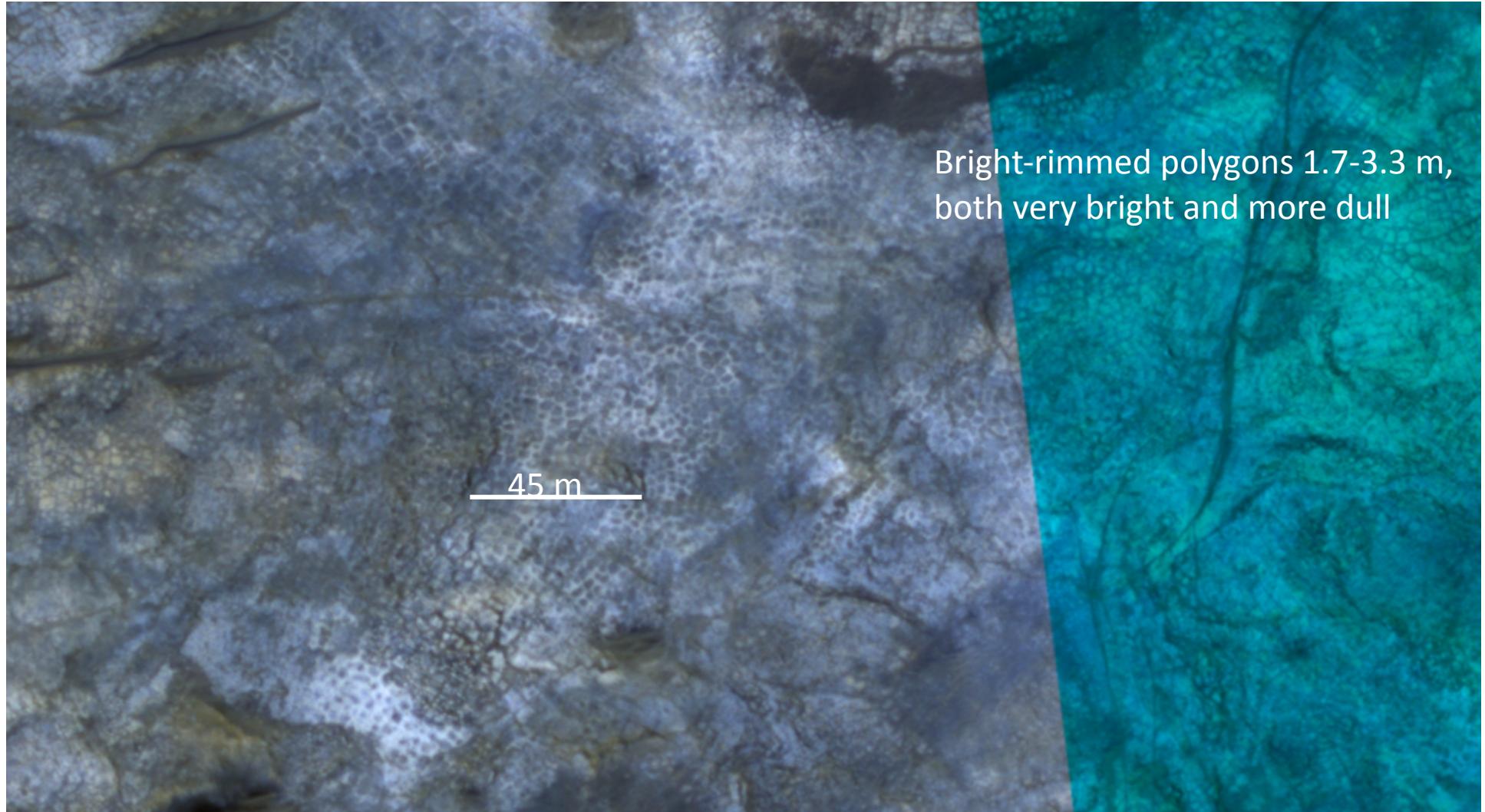


Bright-rimmed Al-phyllosilicate

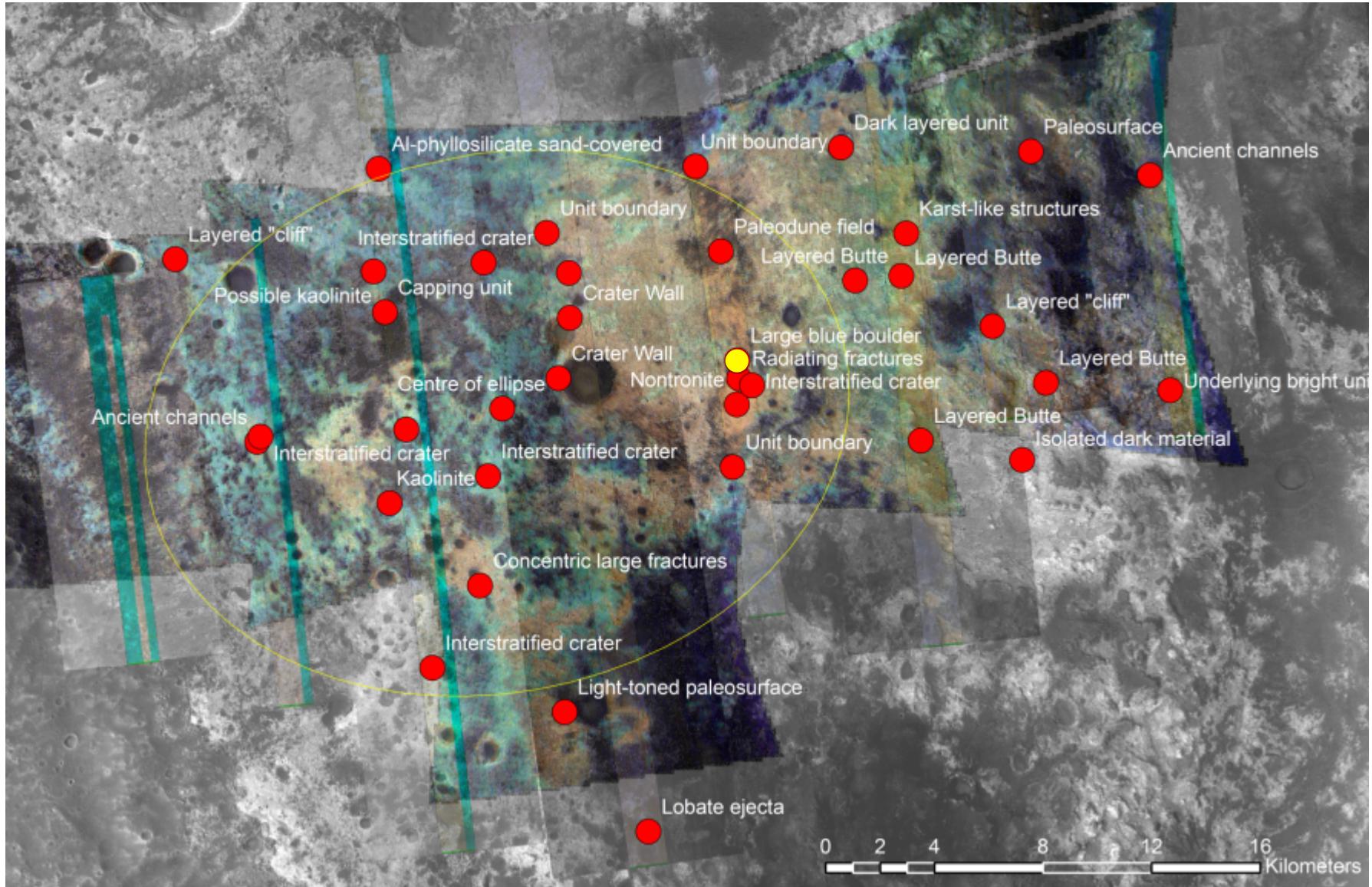


Bright-rimmed polygons

PSP_005964_2045

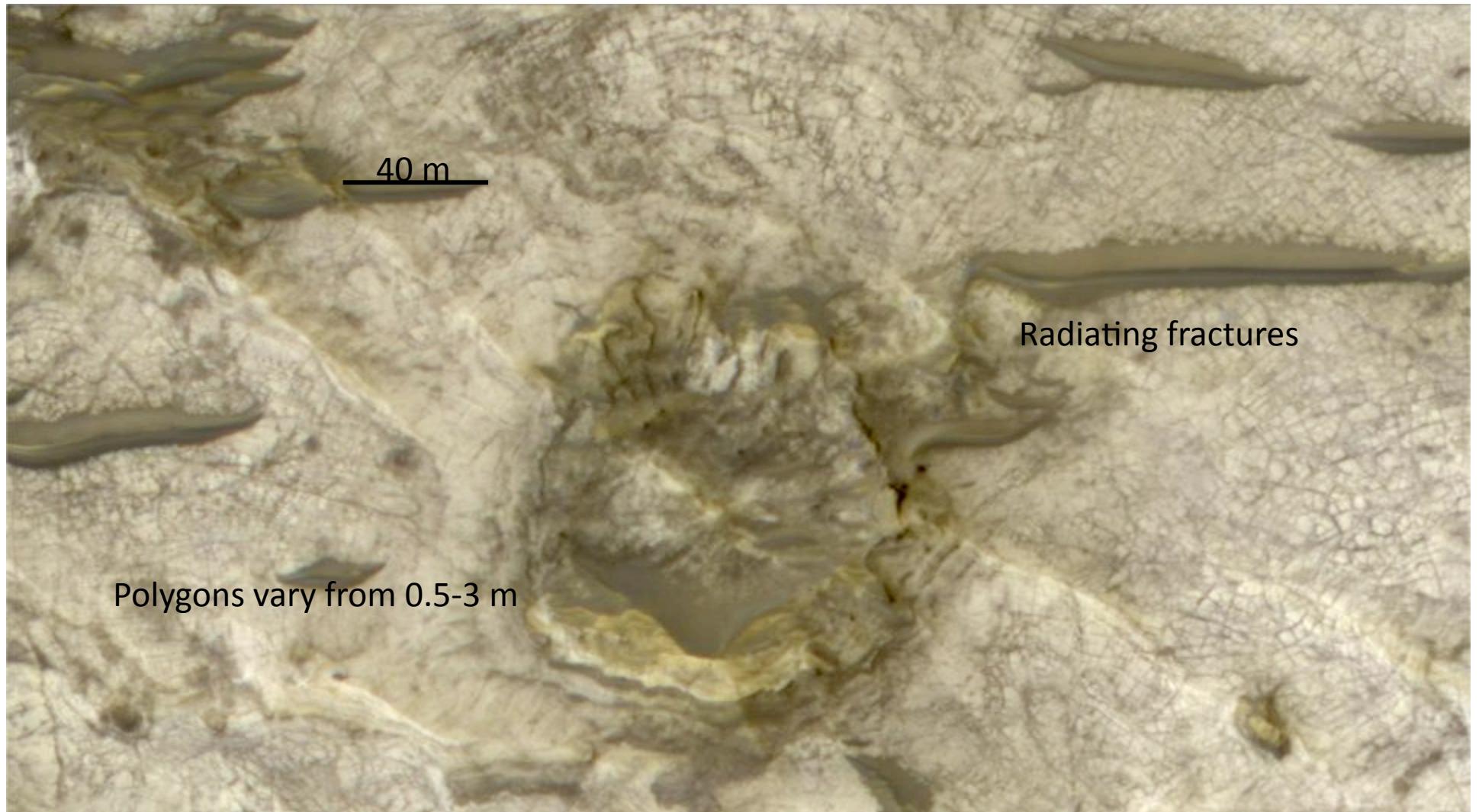


Radiating fractures



Radiating fractures

PSP_007612_2045



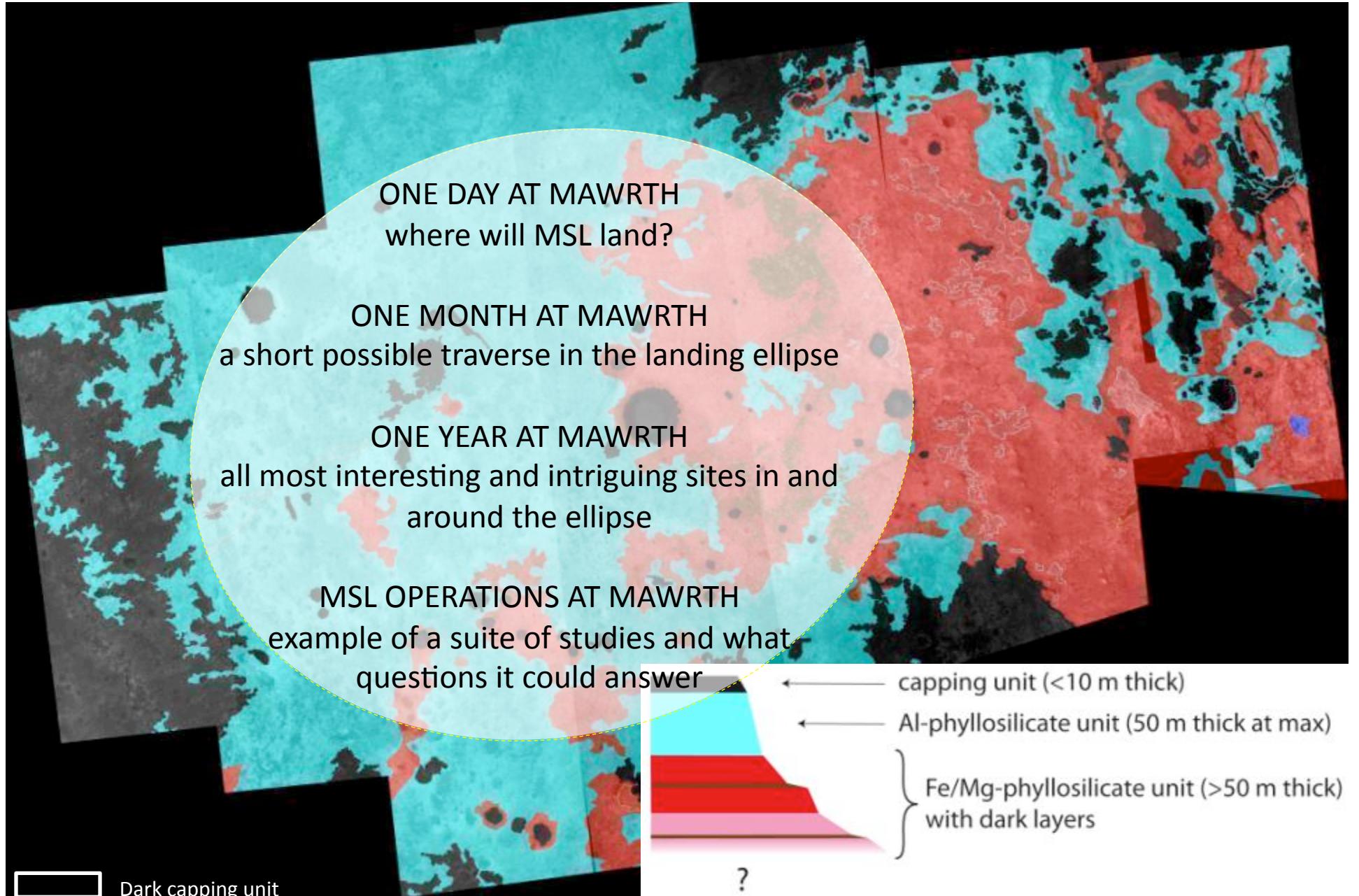
ONE DAY at Mawrth Vallis

Given the present (remote) knowledge of the terrains within the ellipse, wherever MSL will have landed, it will discover a site of a type never explored before, as being much more ancient, dominated by hydrated minerals formed at a time Mars might have harbored habitable conditions.

HoweverThus the usual question: “Where have we landed?” will

How is the surface around MSL, right after landing?

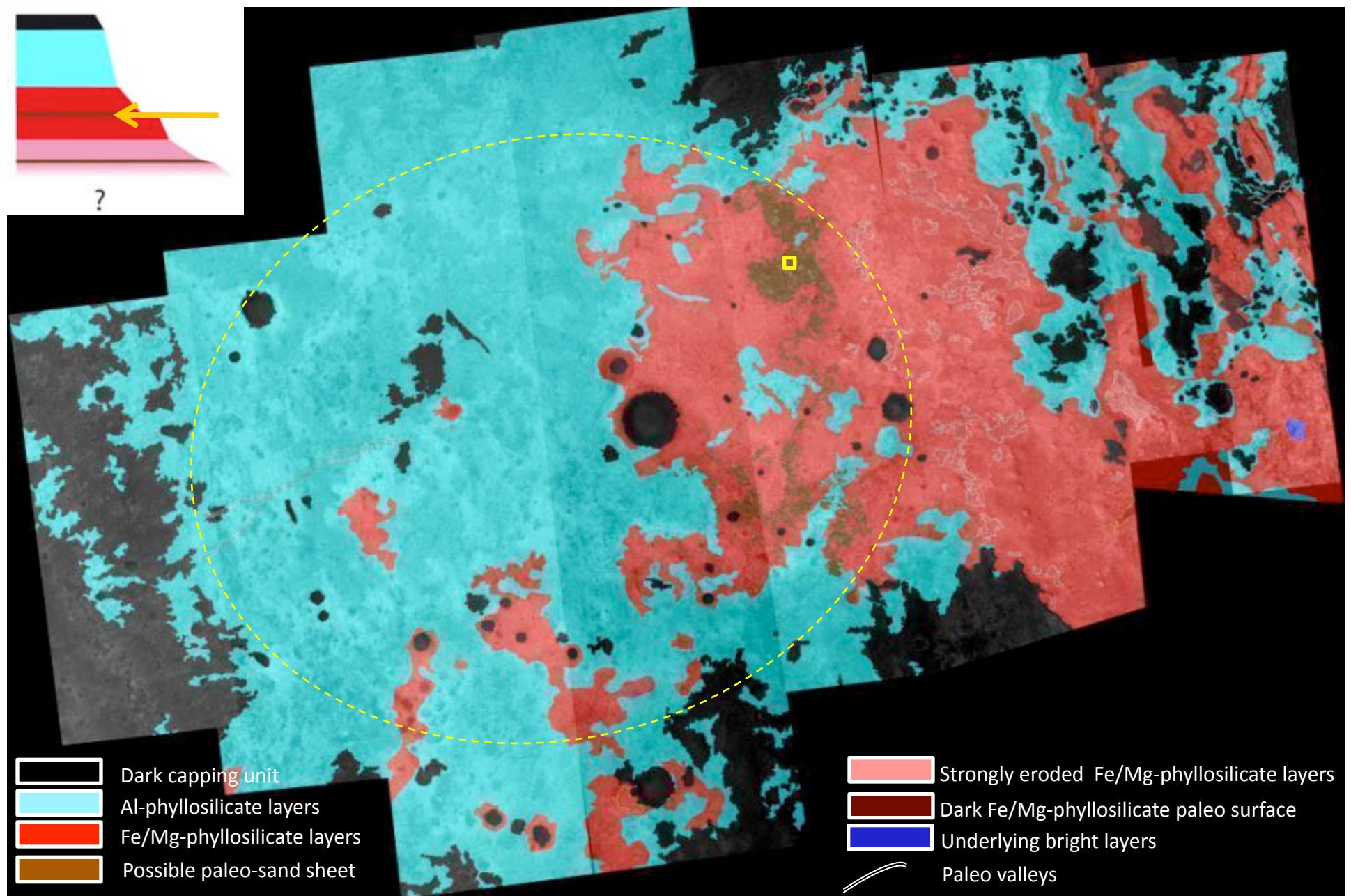
Some full resolution HiRISE close-ups with “MSL scale”



Dark capping unit



Possible paleo-sand sheet



Possible paleo-sand sheet



ONE DAY at Mawrth Vallis

Remote characterization of the landing site (MSL parking)

→ imagery (**MastCam**): stereoscopic panorama, with a submillimeter resolution at a few meters.

What landscape? What structures?

Craters/Outcrops/polygons/rocks etc... ?

→ composition (**ChemCam**):

hydrated minerals?

Al or Fe/Mg rich?

Which mafics (through trace elements)?

Heterogeneity: distinct (submillimeter) spots at distances 2 to 7 m

ONE Month at Mawrth Vallis

Example of measurement suite at each station

→ Remote characterization

→ imagery (**MastCam**): structures (stereoscopic panorama)
plus multispectral characterization.

Evidences for aqueous activity (e.g. desiccation features); relationship
between layering and composition (colors):
do they fit or cross? How sharp are boundaries (alteration process)?...

→ composition (**ChemCam**): analyses of samples (rock,
outcrop) identified through imaging, within layers, as a function
of depth (ablation).

ONE Month at Mawrth Vallis

Example of measurement suite at each station

- Close-up characterization
- imagery (**MAHLI**): submillimeter characterization of the context in which samples will be acquired. Color images to identify heterogeneities and petrography. Mineral assemblages and alteration structures → processes (e.g. through veins, cementation, brecciation...)
- composition (**APXS**): global (mm scale) elemental analyses of samples (rock, outcrop, soil), correlated to Chemcam remote identifications, to decipher the macroscopic mineralogy, and insure the collection of the proper samples for further investigations.

ONE Month at Mawrth Vallis

Example of measurement suite at each station

→ Sample acquisition and analyses

→ mineralogical composition (**ChemMin**): major and minor constituents.
Evidence for inclusions (e.g. carbonates within phyllosilicates), tracing
the early environment (greenhouse gases, temperature, pH...)

→ molecular and isotopic composition (**SAM**): present atmospheric
compounds (Martian C, O and H isotopic references, trace gases...);
sample properties (stepwise heating pyrolysis)